MAR 9 1948

Sky and TELESCOPE

In This Issue:

As the 17th Century Saw Them

Comets and Meteors

American Astronomers Report

More About the Great Comet

Northern and Southern Star Charts

★

Vol. VII, No. 5
MARCH, 1948
Whole Number 77
25 cents

★

Orion setting

LETTERS

Sir:

I would like to pass on a thought I have in regard to the 200-inch telescope. So far as I know, the United States has not yet honored an American astronomer or any American accomplishment in the field of astronomy among its postage stamp issues. It seems to me very much in order now that we pay homage to this truly historic achievement by issuing a commemorative stamp or even a set of stamps that would depict the various steps in the creation of the world's largest eye.

The issue could be made in conjunction with the final completion ceremony at Palomar Mountain, which is tentatively scheduled for June of this year. I am sincerely interested in this, for I am deeply proud of our nation's progress in the sciences.

JOHN H. TANNER
1903 Jetton Ave.
Tampa 6, Fla.

Sir:

After reading Mr. Chapman's letter in the January issue, I tried out his method of viewing the lunar pictures on my February and March issues of last year, and the craters Pallas and Bode stood forth in remarkable relief.

Imagine my surprise when the small craters just north of Gambart looked like raised peaks. I unfocused my eyes and looked at these objects in the regular way, but they still appeared inverted. I was holding the pictures on their sides, as is necessary to view the two north-south photos stereoscopically, but when I held one of the pictures right side up the "peaks" became small craters. Turned sideways again, they looked like craters for one or two seconds, but rapidly changed to assume the same raised aspect.

This has renewed my interest in the inversion phenomenon of lunar craters. I believe that the inversion is produced mentally, and that much depends upon how a person first sees them.

DONALD O'TOOLE
114 Claremont Ave.
Vallejo, Calif.

Sir:

I would like to describe a much simpler method and more beautiful stereoscopic effect than that discovered by Mr. Chapman, using only one photograph or one landscape scene. Just hold the picture at about reading distance from the eyes, gaze at it three or four seconds steadily, then close one eye. In a second or two stereoscopic perspective will jump into the picture.

The reason for this effect is that when viewing with both eyes the parallax of vision of each eye intersects the other at the surface of the paper, indicating to the brain the equal distance of all parts of the picture, so it appears flat, which it really is. But when one of the eyes is closed, thus depriving the brain of the use of the parallax vision, the remaining eye suddenly focuses to infinity, thus failing to indicate the distance of the picture at all, and so the brain itself resolves the natural perspective into the picture. The brain's "vision" reverts to what the original of the picture was and supplies the picture with the natural background and foreground effect.

DANIEL D. WELLS
Route 4, Box 172
Milton, Fla.

Sir:

This is a note on how to tell an asteroid from a nova! On December 30, 1947, at 10:30 p.m. EST, a 6.4-magnitude interloper was noted in the field of the variable star 074922, U Geminorum. As it was of the cream color one has learned to associate with objects in the solar system rather than the greenish hue sometimes affected by novae, and therefore had not that "new look," the immediate impression was that it was an asteroid.

Its position was estimated by eye and marked on the AAVSO U Geminorum "d" chart. Two and a half hours later it had moved 1¼ minutes of arc northwest. The writer was therefore able to go to bed secure in the knowledge that he had not passed up a chance to report a nova. Twenty-four hours later the asteroid had moved 15 minutes of arc from its original position, or at the rate of 1½ minutes in 2½ hours. Evidently the first estimate of 1¼ minutes was very nearly correct.

The telescope used was a 6-inch portable reflector with a 75x orthoscopic eyepiece. This was the second time in two years that an asteroid has been noted by me passing through a variable star field. At Christmas time, 1945, a 6th-magnitude asteroid was seen in the field of 042215, W Tauri.

DAVID W. ROSEBRUGH
87 Fern Circle
Waterbury 69, Conn.

Sir:

During the penumbral lunar eclipse of November 28th, I took a series of photographs, 40 exposures through my 8-inch Newtonian using a Barlow lens which gave an image of about 1¼-inch diameter. The first series began at 12:54 a.m. CST, continued to 1:33 a.m. with three-minute intervals; the second series was designed to catch mid-eclipse; the third series ran from 3:32 a.m. to 4:17 a.m.

The first suspected darkening due to the penumbra was at 1:03 a.m., first definite at 1:09 a.m. I cannot determine mid-eclipse from the second series — they all look alike. The last definite darkening was at 3:59; the last suspected at 4:08 a.m.

J. RUSSELL SMITH
320 Main St.
Eagle Pass, Tex.

Sky and Telescope

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CONTENTS

COVER: Orion setting over Teaneck, N. J., photographed by John Stofan with a Graflex f/4.5 camera. The foreground building has been added to the print from a separate negative. (See In Focus.)

AS THE 17TH CENTURY SAW THEM — James C. Bartlett, Jr. 115

COMETS AND METEORS — Robert R. Coles 117

AMERICAN ASTRONOMERS REPORT 123

MORE ABOUT THE GREAT COMET 125

Amateur Astronomers 120
Books and the Sky 126
Gleanings for A.T.M.s 128
Here and There with Amateurs 138
In Focus 116
Letters 114
News Notes 119
Observer's Page 132
Planetarium Notes 136
Southern Star Chart 139
Stars for March 137
Terminology Talks 122

BACK COVER: A drawing by Russell W. Porter of the 200-inch telescope on Palomar Mountain, as viewed looking toward the east. (See In Focus.)

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As the 17th Century Saw Them

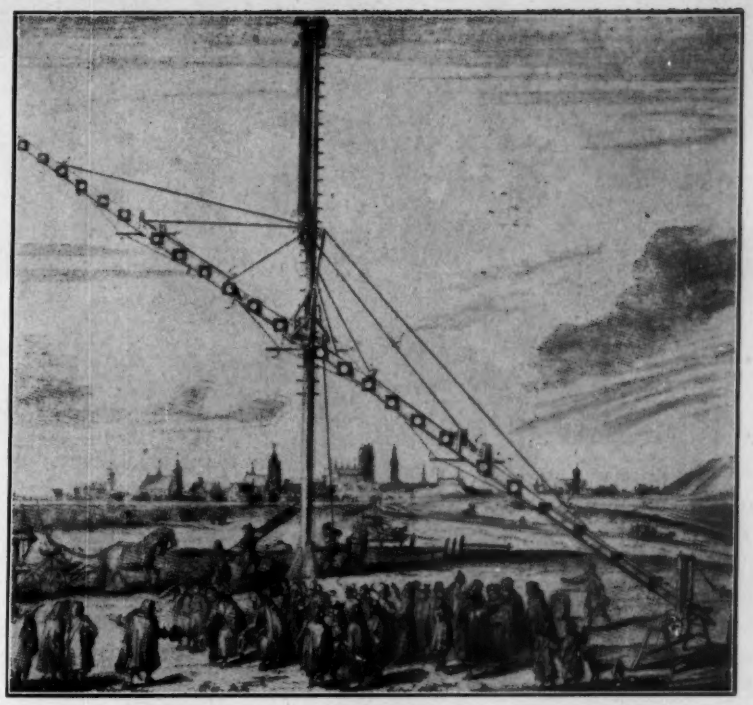
By James C. Bartlett, Jr.
American International Academy

Backward, turn backward, O Time in your flight!
Make me a child again, just for to-night!
—Elizabeth Akers Allen

HOW OFTEN have all of us echoed that poignant plea! And how often, perhaps, have modern star gazers wondered how the heavenly bodies looked to the childhood of telescopic astronomy. It occurred to this writer to find out, and, not having the advantage of a Wellsian time machine, he did the next best thing and used simple objectives of enormous focal ratios to project himself into the past.

When Galileo developed the primitive refractor it suffered from two major imperfections. It was not achromatic and it was not corrected for spherical aberration. In a simple lens the light is dispersed in such a way that the different wave lengths, that is, the different colors, are brought to different focal points. And if such a lens be the section of a sphere, the parallel rays of a pencil of light passing through it do not all come precisely to the same focus. The net result is a varicolored and confused image in which practically nothing can be seen.

Yet it was with just such an instrument that Galileo unlocked the treasure house of heaven on that fateful evening in September, 1610, and simultaneously released the human intellect from servile bondage to dead tradition. For Galileo, peering through his crazy "optik tube," saw enough to convince him that Venus exhibited phases like the moon; and thus he ended forever the long reign of the Ptolemaic tyranny which had caused Alfonso of Castile to complain, "If I had been consulted at the creation, I could have done the thing better than that!"



Hevelius' 150-foot telescope, an example of a long-focus 17th-century refractor. From "Splendour of the Heavens."

Even earlier, in January of that year, Galileo had discovered the four large satellites of Jupiter. He also observed the mountains on the moon, the fact that the sun rotates, and even *partially* saw the rings of Saturn. All this with means inferior to a modern spyglass!

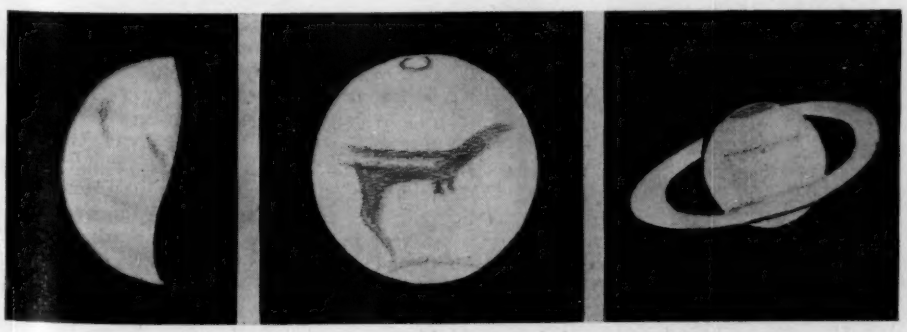
Immediate attempts were made to improve the refractor, following publication of Galileo's epoch-making discoveries. In the main these attempts took two forms. One school of thought favored larger objectives with longer focal lengths, and simple lenses possibly up to six inches in diameter were actually ground. With such lenses and increased focal lengths, "the image was no more confused when the focal length was sixty feet than when it was six," as Newcomb remarked. Greatly increasing the aperture and lengthening the focus resulted in a much larger image with the same power at the eyepiece. Thus, something more could be seen in this larger image despite the confusion.

But this was a clumsy solution of the problem, and other experimenters rather favored keeping the objective small while enormously increasing the focal length. It was found that a small lens of very flat curve — and therefore of very long focal length — would give a much less confused image. Indeed, when the curve was flat enough a *sharp* image almost wholly free of color was obtained.

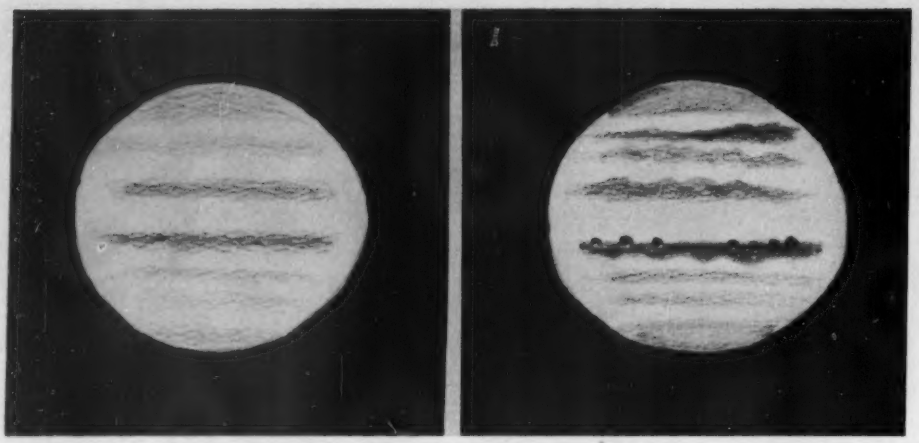
This solution, clever though it was, also suffered two major disadvantages. It fixed the diameter of the objective too low, because a comparable focal length with a larger lens would have imposed a tube so unwieldy that it could not be managed. Secondly, even the focal ratios necessary to distinct vision with the tiny objectives resulted in tubes which were marvels of engineering and which required almost the services of an engineer to manipulate them!

Thus, J. D. Cassini, first director of the Paris Observatory, used one instrument of slightly less than 2.5 inches aperture with a focal length of 20 *feet*. Others, with comparable apertures, used focal lengths even greater. In some cases these exceeded 100 feet and were so cumbersome that the telescope tube had to be entirely abandoned, the objective being mounted on the far end of an enormously long pole with the eyepiece at the opposite end.

The problem of mounting such instruments was variously met. With the more gigantic, the whole tube rested on



Venus, Mars, and Saturn, as observed by the author with very small, long-focus objectives. The drawing of Venus was made on January 17, 1945, at 5:25 p.m. EST. Mars and Saturn were observed with a ¾-inch objective of 90 inches focus, on October 5, 1941, 9:10 p.m. EST, and September 22, 1941, 12:50 a.m. EST.



On the left is Jupiter drawn as seen on August 2nd, last year, through one of the author's small aperture, long-focus objectives. A drawing through a modern reflector, made immediately following, is at the right.

a sort of trestle which in turn was slung from overhead pulleys or booms by means of ropes or chains. A sweating assistant or two were required to haul on the ropes and thus swing the instrument about at the command of the observer, something like a sailor changing the set of the sails on a windjammer. Yet with such contraptions Cassini discovered the division between the rings A and B of Saturn, four of the Saturnian moons, and learned that Jupiter does not rotate like a solid body; Bianchini did pioneer work on the rotation of Venus; Huygens resolved the rings of Saturn and discovered Titan; and he and Hooke even observed the markings on Mars and made drawings from which these markings may be identified today.

Manifestly, such discoveries could not have been made with the confused rainbow images of Galileo's day. Approximately how did the planetary images appear to those 17th-century pioneers? In order to answer this question, and incidentally to discover what might be seen with the smallest practicable apertures, the writer experimented with several simple objectives ranging in aperture from 0.5 to 0.75 inch, with focal lengths from 56 to 90 inches. These were mounted in ordinary cardboard tubes, of the kind used as cores for rolls of yard goods, and employed with a simple Huygenian eyepiece.

These tiny objectives gave sharply defined, colorless images which were quite brilliant for their size. All the *characteristic* planetary features could be seen, including the rings of Saturn and the major belts of Jupiter, something of the Martian markings, irregularities in the terminator of Venus; also sunspots, and quite a wealth of lunar detail. From these results it was easy to understand how Cassini and others discovered so much with so little.

With stars there was less success, because all but the very coarsest doubles closed up. The Double Cluster in Perseus and M41 in Canis Major were impressive, but even the brightest nebulae were mere wisps of celestial fog. It is therefore significant that the 19th century, rather than the 17th, was the period of great stellar discoveries. Nevertheless, in 1650 Riccioli found that Mizar was a telescopic double (separation 14″.6).

I have drawn Venus as seen through a ½-inch objective, f/120. Note the irregular curve of the terminator, the blunting of one of its horns, and even the suggestion of streaks. We can understand how Bianchini, in 1726-27, with an aperture of 2.5 inches and a focal length of 66 feet, saw enough of the shadowy Venusian spots to enable him to construct a map.

My drawing of Mars was made through a ¾-inch objective, focal length 90 inches. It was from similar drawings made by Hooke in 17th-century England that Proctor was able to obtain the remarkably accurate value of 24 hours, 37 minutes, 22.73 seconds for the rotation period of Mars.

The two drawings here compare Jupiter as seen through a ½-inch lens of 56 inches focus and as observed a few minutes later with a 3.5-inch modern reflector. Notice that the *characteristic* markings are visible with the small aperture, but the modern view gives enormously greater detail in the same markings.

Finally, Saturn is shown as Huygens may have seen it when he discovered the true nature of the rings in 1655. My objective was the same as that used for Mars. The rings appear solid, although the bright equatorial band is visible on the ball of the planet. There is suggestion of a belt, and the dark cap at the south pole shows.

Anyone wishing to duplicate these results, but perhaps not having access to such small objectives of these focal lengths, may approximate them in the following way:

Obtain one or two simple concave lenses (spherical) such as are used for eyeglasses, with as long focal lengths as possible. Opticians often carry in stock 2-inch concave lenses with focal lengths of 25 to 30 inches. Mount them in any convenient manner and use a Huygenian eyepiece. The image will be confused and varicolored, as it was in Galileo's day (his eyepiece was a negative lens).

Now prepare cardboard diaphragms with apertures of 0.5 and 0.75 inch, and mount these in front of the objectives. In effect, you will have object glasses with ratios of f/60 and f/40 respectively, assuming that the original focal length of the full aperture was 30 inches. These will not yield quite as clear images as those obtained by the writer with greater focal ratios, but you will be amazed at the improvement. But what is more, you will be seeing the planets approximately as they must have appeared in the early days of telescopic planetary explorations.

In Focus

THE FRONT-COVER PICTURE this month, writes John Stofan, of 332 Herrick Ave., Teaneck, N. J., is a genuine star-trail photograph, untouched in any way except for the addition of the building in the immediate foreground from a separate negative. Mr. Stofan attributes the intensity of the trails to use of large aperture, fast panchromatic film, strong development — and clear atmosphere. "The appearance of the trails in front of the trees, rather than obscured by them, is caused by swaying of the branches during the long exposure."

The camera, equatorially mounted, was a Graflex, 3¼ x 4¼, with an f/4.5 lens at full aperture. Super XX film was used, and D-19 developer. The stars were allowed to trail for 2½ hours, and then the lens was capped for five minutes to provide the gap between the trails and the star images. The stars were then followed for 30 minutes with a small guiding telescope on the same mount, manually with a slow-motion screw. During this exposure a diffusion disk was placed over the lens to increase the starry and hazy effect of the individual stars.

On the back cover this month appears another of the famous Porter drawings of the 200-inch telescope in one of its many different aspects. This is the second of a series of such reproductions which will appear from time to time. The first, in the January issue, was an overall picture of the instrument and dome, illustrating in Russell W. Porter's graphic style many of the significant and interesting points about the mighty Palomar giant.

This month the drawing is primarily of the instrument, showing an observer working at the f/16 Cassegrainian focus, taking a spectrogram of a celestial object. Note his assistant at the controls in the base of the north pier.

The pictures in this back-cover series are being reproduced by courtesy of California Institute of Technology.

Comets and Meteors

By Robert R. Coles, *Hayden Planetarium*

DESPITE the dearth of spectacular comets in the Northern Hemisphere in recent years, there exists a tremendous popular interest in them as shown by the avalanche of inquiries received by planetariums and observatories when Comet 1947n was announced. Most of the inquiries were from individuals who wanted to know when and where to watch for the new comet. A few indicated that some persons still view these cosmic visitors with a superstitious dread. This fear is not surprising, however, when we consider the tremendous following enjoyed by the pseudo science of astrology today. We received one telephone call at the Hayden Planetarium last December from a much distraught male who beseeched us to aid in assuring his wife that the great comet then being observed from the Southern Hemisphere would not bring about the end of the world.

Some people, too, have a very mistaken idea as to how a well-behaved comet is supposed to appear. Much of this is due to the unfortunate choice of words employed by the press in describing these cosmic visitors. When a comet is said to be "streaking across the sky," the implication is that it is flashing through the heavens like a meteor. While at least some meteors are associated with comets, the two phenomena present quite differing appearances to us as we see them in the heavens.

Meteors, or "shooting stars," are solid bodies that enter our atmosphere from outer space and are heated to incandescence as they plunge toward the earth. They are observed as momentary streaks of light that are usually gone as suddenly as they appear. The meteor may leave an enduring train of luminous vapor in the sky, but the meteor's bright passage lasts for no more than a few seconds.

A comet, on the other hand, is many millions of miles beyond the earth, even at its brightest as we see it. It travels in an orbit around the sun and may be observed for several weeks or even many months. While its orbital speed may be very great, it appears to change its position gradually against the background of stars, much as planets do. Comets are never seen to streak across the sky.

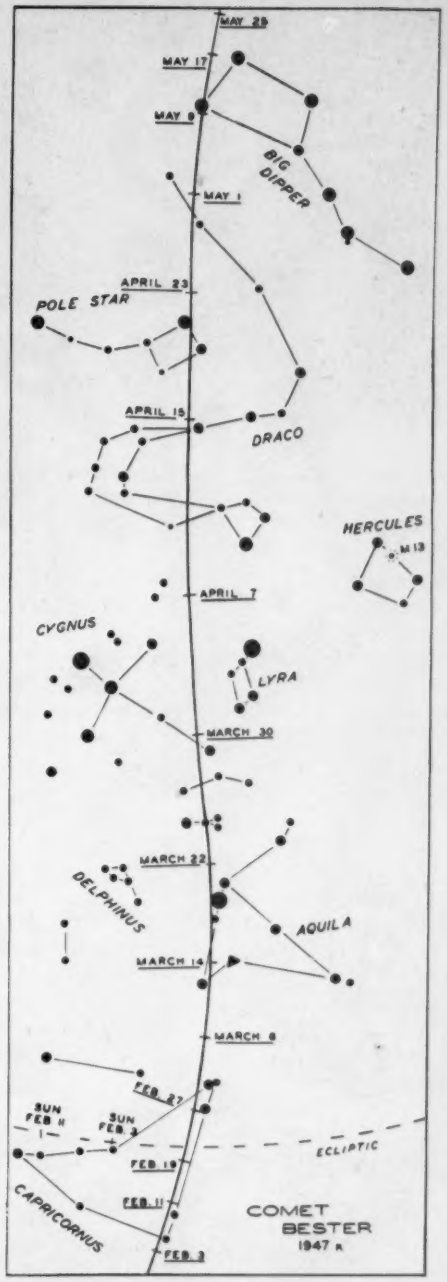
In his book on comets, Charles P. Olivier tells us that the ancient Pythagoreans thought them to be cosmical bodies that followed planetary orbits and returned at definite periods. But the followers of Aristotle contended that comets were meteorological phenomena and confined to the earth's atmosphere. And the authority of Aristotle so dominated popular opinion that this theory prevailed generally until it was disproved by Tycho Brahe during the last quarter of the 16th century.

Today it is definitely known that a very large number of comets belong to the solar system. They circle the sun on elliptical orbits and return to our part of the sky very regularly. Encke's comet has the shortest period known today, 3.3 years. More than two score comets have periods from five to 12 years and are members of Jupiter's family of comets. Some other comets take decades, some centuries, while comets like 1947n have periods of almost incredible length. Halley's comet has a period of 76 years; it last visited the sun in 1910 and should be back about the year 1986. This year, 1948, marks the attainment of its aphelion, greatest distance from the sun, beyond the orbit of Neptune, where it has been suggested that the 200-inch telescope might be able to observe it.

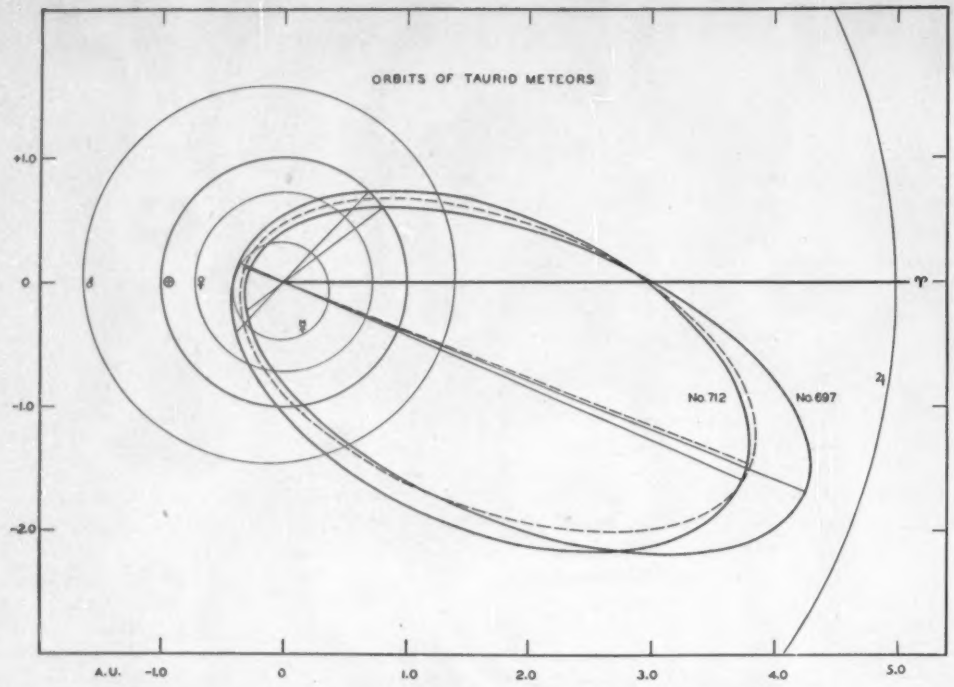
While many comets appear to be following hyperbolic orbits that would eventually carry them away from the solar system, never to return, this may not actually be the case. In most instances, we can observe a comet through only a very small part of its entire orbit, and if it is a long-period comet the difference between that part of the ellipse we see and a parabola (eccentricity = 1) is very slight. For convenience, the orbits of such comets as 1947n are computed as if they were parabolas and the apparent positions in the sky are predicted on such an assumption. This procedure does not mean that astronomers can be certain the orbit is closed or not, although further observations may serve to establish a definitely elliptical orbit — a definite hyperbolic orbit has never been found.

Comets have been described as the renegades of the solar system. While the planets move from west to east always near the ecliptic, comets may have orbits with any orientation and may travel along them in either direct or retrograde motion. Thus, comets sometimes seem to violate the celestial traffic laws and we may even see them in such regions as the lair of Ursa Major, the Great Bear, where no law-abiding planet would ever be seen (except possibly an unusual asteroid). Bester's Comet 1947k will pass through the bowl of the Little Dipper and very near the first Pointer star of the Big Dipper, as the accompanying chart of its path shows.

Comet 1947k was originally discovered in the Southern Hemisphere, but the inclination of its orbit, combined with other factors, makes its apparent path in the heavens for this month and next almost due north. Predictions of its magnitude may be made on the basis that the brightness varies as the fourth power of the distance from the sun, in other words, a change of the distance by two would change the brightness by 16 times, or about three magnitudes. The comet was at perihelion, three fourths of an astronomical unit (about 70 million miles) from the sun, on February 16th, when the fourth-power law would make its brightness about 5th magnitude. But some comets brighten even more rapidly, and a sixth-power law of variation would make this perihelion magnitude about 2.5. But at that time the comet was too close to



The approximate path of Comet Bester (1947k), from February through May, 1948, as predicted by an ephemeris computed by Leland E. Cunningham. Note the proximity of the comet and the sun early in February.



Projected orbits of two Taurid meteors and Encke's comet (dashed line), after Whipple. The orbits of the planets out to Jupiter are shown.

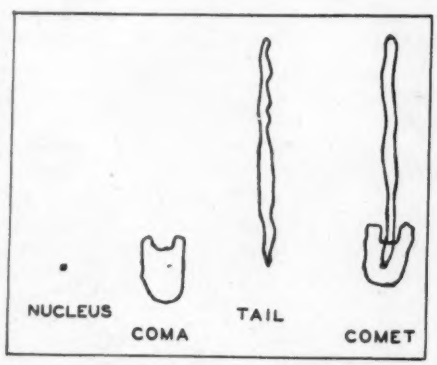
the sun to be readily observed by us.

During March and April, the comet will get fainter, but not as fast as otherwise would be the case, because it is getting closer to the earth all the time, the nearest approach occurring about April 6th at a distance of three fourths of an astronomical unit from the earth. Its brightness this month should be between 3rd and 5th magnitude; next month, 5th and 7th; and in May, 7th and 9th, according to the ephemeris computed by Dr. L. E. Cunningham, Students' Observatory, University of California at Berkeley. But it should be remembered that the comet may behave erratically and be considerably brighter or fainter than the predicted magnitudes on either the fourth-power or the sixth-power law.

While it is true that many persons have gone through life without ever having seen a comet, there are relatively few who have not thrilled at the unexpected appearance of a meteor. Many recall some unusually spectacular fireball that burned a trail through the night sky and suddenly illuminated the landscape for miles around. Such an experience may leave a lasting impression that is likely to start the observer inquiring about the nature of shooting stars in general.

It has been estimated that several billion meteors enter our atmosphere every 24 hours, the vast majority of which are no larger than a grain of sand. Most of these burn themselves out before reaching the surface of the earth. A few survive the ordeal, however, and many of these have been recovered. They are then referred to as meteorites, and they include some giant specimens weighing many tons.

Many meteors are sporadic, appearing haphazardly without relation to other meteors. Some astronomers believe these to be lone wanderers from space that come within the influence of the earth's gravitational field, but the evidence of recent photographic observations of meteors does not confirm that any of them originate outside of the solar system. Other meteors travel in swarms about the sun and produce the meteor showers that we experience at various times throughout the year. A good number, if not all, of these swarms are associated with comets. To understand how they are related, let us consider something of the constitution and behavior of a comet.



How the nucleus, coma, and tail of a comet combine to give its observed appearance. From "Between the Planets," by Fletcher G. Watson.

A typical comet has a nucleus which is made up of a mass of solid meteoritic particles held together by their mutual gravitational attraction. The particles may vary greatly in size and be separated by relatively large distances, and the nucleus may be several hundred miles in diameter. Surrounding this is a fuzzy envelope called the coma, or head, and it is probably a mixture of gaseous molecules and solid particles. The coma may be several thousand miles in diameter, and the largest comets have heads exceeding 100,000 miles in extent. As the comet approaches the sun, some of the gaseous material may be forced out on the side opposite the sun to form the tail. Because of the growing activity of the comet and the increased radiation pressure, the tail usually increases in length as the comet nears the sun — diminishing again as it recedes. Some comet tails have been seen as equal in length to the distance from the earth to the sun.

Of all celestial objects, comets are the least stable. They frequently alter their appearance greatly in a few hours, and occasionally they have disintegrated almost before the eyes of the observer. It is the debris of such comets that gives us some of our most spectacular displays of celestial fireworks — meteor showers. There is the case of Biela's comet, which was discovered in 1772. Its period was about six years, and it was seen in 1815 and 1826. For some years thereafter it seemed to behave in normal fashion, and in 1845 appeared on schedule. But early in January, 1846, it was seen to be composed of two parts, and this double comet returned on schedule in 1852, one component considerably brighter than the other.

It was 20 years later, however, that the earth ran into the swarm of meteors associated with the orbit of Biela's disrupted comet, and a notable shower of shooting stars was seen radiating from near the star Gamma Andromedae on the night of November 27, 1872. This display was repeated some 13 years later, but the orbit of the meteor swarm has shifted enough now so the earth does not run into it any more. The association of the meteors with the comet is well established, just as it is in the case of the Draconid meteors of October 9, 1946, and Comet Giacobini-Zinner. The annual August Perseid meteors are associated with Tuttle's comet of 1862, and the Taurids with Encke's comet.

The business of hunting meteors in the night sky is a thrilling adventure open to anyone who cares to participate. In spite of such advances as the use of radar and two-station fast-camera photography to pin down the heights and velocities of meteors, visual observers may still make very real contributions to the science. If you are looking for a new field with no end of exciting possibilities, join the ranks of meteor hunters who find every clear night an open season and no limit on the take.

NEWS NOTES

By Dorrit Hoffleit

STARS WITH UMBRELLAS

For the third time in 22 years Dr. Donald H. Menzel, of Harvard College Observatory, has been the recipient of the A. Cressy Morrison prize, awarded by the New York Academy of Sciences for the best paper dealing with research in a specified field. Dr Menzel's subject was "Energy Sources in Giant Stars."

As described in Lawrence H. Aller's article in last month's *Sky and Telescope*, the carbon cycle does not provide an explanation of energy generation in the giant stars, which are noted for their large size, low density, and calculated central temperatures too low for the carbon cycle to operate. Yet for these stars the observed average generation of energy per gram is extremely high.

Previous stellar models to which the carbon cycle is applicable have always postulated static equilibrium for the stellar atmosphere. This is the important point of departure in Dr. Menzel's theory, for he investigates whether a *dynamic* envelope can be responsible for the observed phenomena. In reading his paper one feels the author's own agreeable surprise that so many different classes of objects are amenable to this proposal: Merrill's symbiotic stars (showing both high and low excitation phenomena simultaneously), Wolf-Rayet stars and planetary nebulae, novae of the ordinary and recurrent types, long-period variables and Cepheids. Each of these objects appears to have a relatively small nucleus surrounded by a large distended atmosphere, in some cases by shells.

Solar studies, particularly of prominences, sunspots, and the corona, and stellar spectra provided Dr. Menzel with his clues and postulates. His dynamic model is not exactly conventional — a star with "umbrellas." If the photosphere of such a star is envisaged as the envelope of irregular, filamentary prominences, there will be places where radiation from the deeper interior can shine through, showing the hotter spectrum of lower layers. In general, "high-temperature radiation from the inner surface, escaping through the outer umbrella of prominences, automatically changes to low-temperature radiation characteristic of the net flux." In nova outbursts, material is ejected primarily in the polar directions, creating nearly symmetrical diametrically opposite umbrellas which shield the star proper, not from the downpour from above, but from the escape of radiation from within. The spectra of such stars would depend on the aspect of the umbrellas relative to the observer, accounting for some of the individual differences among otherwise similar objects.

In summarizing, Dr. Menzel states, "Fitting a distended, dynamic atmosphere to a Wolf-Rayet core, for giant stars in general, removes the main difficulties concerning energy generation in such objects. The hypothesis unifies many types of stellar variation. Supernovae remain as the outstanding puzzle." Other aspects of the problem promise fruitful future research, particularly the new concept of energy conversion to radio waves. For example, what happens when R Coronae Borealis loses brightness by a factor of 1,500 and shows no major spectral changes? Could the star be regarded as a single "starspot," growing dark when it converts most of its energy into radio waves? The prize-winning paper is chock-full of suggestions.

UPPER ATMOSPHERE TEMPERATURES

Last April one of the greatest explosions in history occurred, the destruction of the German Helgoland naval base with 5,000 tons of TNT. Dr. Everett F. Cox, of the Naval Ordnance Laboratory, took advantage of the "experiment" to measure the temperature in the upper atmosphere by sound transmission. It has frequently been observed that sounds from explosions are sometimes heard at great distances while more nearby points are in zones of silence. High, warm regions of the atmosphere reflect outward-going sound waves back down to the earth. A special U. S. Navy expedition observed the Helgoland blast at various points, the farthest 620 miles away at Gorizia, Italy, where the sound was of too low a frequency to be heard by ear.

In general, Dr. Cox's array of temperatures agrees with previous estimates, confirmed by data from V-2 rocket flights. According to Science Service, he finds that it is 50 degrees above the boiling point 100 miles up, whereas at about 45 miles it is 150° F. below zero. The ozone layer produces a warm zone between heights of about 20 and 40 miles, as a result of its absorption of ultraviolet sunlight.

AUTOMATIC GUIDING

Constant guiding has always been necessary for photographic work with the largest telescopes. The 200-inch also will require guiding, but it need not be manual. Dr. Horace W. Babcock, of Mount Wilson Observatory, has developed a photoelectric guiding device which is now in regular use on the 100-inch for high-dispersion spectrographic work. The new equipment operates on the principle of the "rotating knife-edge," working in two co-ordinates and employing a 1P21 photomultiplier tube.

In spectrographic work the stars examined are usually brighter than the guide stars available in most direct photography, making this device easily adaptable. A part of the light that shines on the spectrograph slit does not pass through, but is reflected back into a small guiding telescope whose eyepiece is converted into a scanning device by a small internal coaxial tube, mounted in ball bearings and rotated by a miniature motor. At the focal plane, within the rotating tube, is a half-disk or knife-edge covering one half of the field. A deviation of a star from the axis of rotation results in modulation of the light transmitted by the eyepiece into the photocell, and activates a mechanism for adjusting the orientation of the telescope.

Dr. Babcock states that the resulting guiding is as accurate as that by a careful human observer, and that the theoretical limit for its use with the 100-inch telescope is about the 13th magnitude. Its present use has been restricted mainly to stars brighter than the 8th magnitude.

DID A METEORITE DO IT?

In South Africa there is an unusual topographical feature whose origin seems to have defied explanation on the basis of orthodox geological dynamics. Roughly circular and about 30 miles in diameter, the formation is known as the Vredefort ring structure, and if it were proven to be the result of meteoric impact it would be the first meteor crater of such dimensions ever discovered on the earth.

Of five geological theories, two have supposed magmatic upthrust to be the primary cause of the ring formation; a third, tangential force of the kind ordinarily applicable to mountain building; and two gave varying combinations of upward and lateral forces. Proof of the meteoritic theory, proposed by Boon and Albritton 10 years ago, by the finding of meteoritic fragments seems almost impossible since the erosion of over 200 million years has destroyed the original relief and may have removed all meteoritic remnants. But analogies and theoretical considerations, summed up by Professor Reginald A. Daly, of Harvard University, in the *Journal of Geology* for May, 1947, lend plausibility to a meteoritic origin.

Its center located in east longitude 27° 30′, south latitude 27° 0′, the Vredefort ring structure experienced what Professor Daly calls its "amazing deformation" at some epoch long before the Carboniferous era, perhaps as early as the late Pre-Cambrian. Subsequent erosion to a peneplain was followed by a comparatively recent cover of Karroo sediments, now stripped off about two thirds of the area. The original crustal layers slope upward toward the central hollow, and in places they are even tilted more than 90 degrees, so that some of the older, formerly deeper layers are ac-

tually on top. In the center, an old granite core intrudes as a dome under the cavity.

Compared with Meteor Crater in Arizona, the South African formation is gigantic. The Arizona crater was probably originally about 1,100 meters wide and 400 deep. The one at Vredefort must have exceeded 50,000 and 15,000 meters in width and depth, respectively. The difference in the magnitude of the phenomena would help to account for most of the observed features: the upturned strata, shattered granite, and even the central core, the last resulting from differential upward bending of the crust during isostatic adjustment after the "explosion." All this may have happened on the impact of a very large meteorite at a geologic time when the earth's crust was thinner than now and had a steeper thermal gradient. In some respects the meteoritic theory can account for most of the observed facts better than any previous proposal.

METEORS AND METEORITES AT THE AAAS

Numerous astronomical papers were presented at the meetings of the American Association for the Advancement of Science at Chicago in December. Meteors and meteorites were abundantly discussed.

Dr. Harrison S. Brown, of the University of Chicago's Institute for Nuclear Studies, theorized on the role of meteorites in determining the age of the earth. His work at Oak Ridge, Tenn., on the separation of chemical isotopes is highly useful in his present researches on meteorites. In an interview for Science Service, he revealed that one of his colleagues recently succeeded in isolating a few milligrams of lead from an iron meteorite. Since this is the final decay product of radioactive uranium, the discovery will aid in the determination of the age of the specimen. For his AAAS paper, concerning the formation of molecules involving iron and silicon under varying physical conditions to produce their observed abundances in meteorites, Dr. Brown received the one thousand dollar prize of the AAAS. At the age of 30 he is the youngest scientist to have won this prize, which has been awarded annually for the past 21 years.

Work of a similar nature was reported by Carl A. Bauer, of the University of Michigan Observatory. His theory that the helium content of meteorites may have been produced by cosmic rays has been reported here previously (*Sky and Telescope*, VI, 11, 9, September, 1947), and he has now extended his study to include the problem of the origin of meteorites and, indirectly, of the earth. He finds the abundance of meteorites of various kinds, irons, stones, and so forth, varies just as would be expected were

(Continued on page 136)

Amateur Astronomers

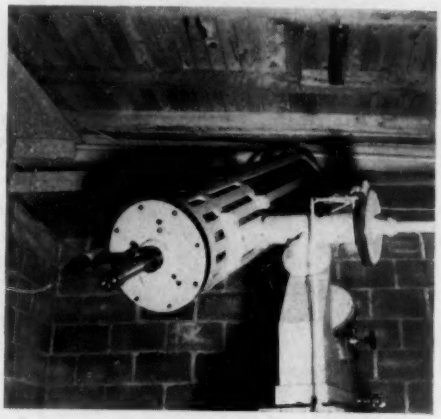
THE NEW OBSERVATORY AT CUMBERLAND UNIVERSITY

ASTRONOMY will be of considerably more interest henceforth to the students of Cumberland University at Lebanon, Tenn., because of the recent gift to that institution by its former president, Dr. Laban Lacy Rice.

During Dr. Rice's tenure of office from 1940 to 1946, he was very concerned with stimulating student interest in astronomy. He gave frequent lectures on the subject, which was not included in the regular curriculum, augmenting his explanations by means of a small telescope through which his audience might view celestial bodies.

In July, 1947, the Rice Observatory, named after its donor, was formally opened. It will be the center of the university's growing astronomy program. The university catalogue lists for the first time in many years a course in astronomy — non-technical and introductory in character to present the astronomical facts, principles, and methods which should be a part of a liberal arts education. Dr. James O. Baird is director of the new observatory and professor of astronomy at the university.

The building is constructed of concrete blocks coated with water-resisting paint. There are two wings, each 30 feet in length, and a 13-foot central dome, ribbed with aluminum and covered with heavy aluminum sheets. In the left wing, beneath a sliding roof-section, is mounted a 12-inch Cassegrainian reflector with an equivalent focal length of 240 inches. The central dome houses a 7-inch refractor, of 96 inches focus. There are six eyepieces all told, providing for magnifications from 75x to 440x.

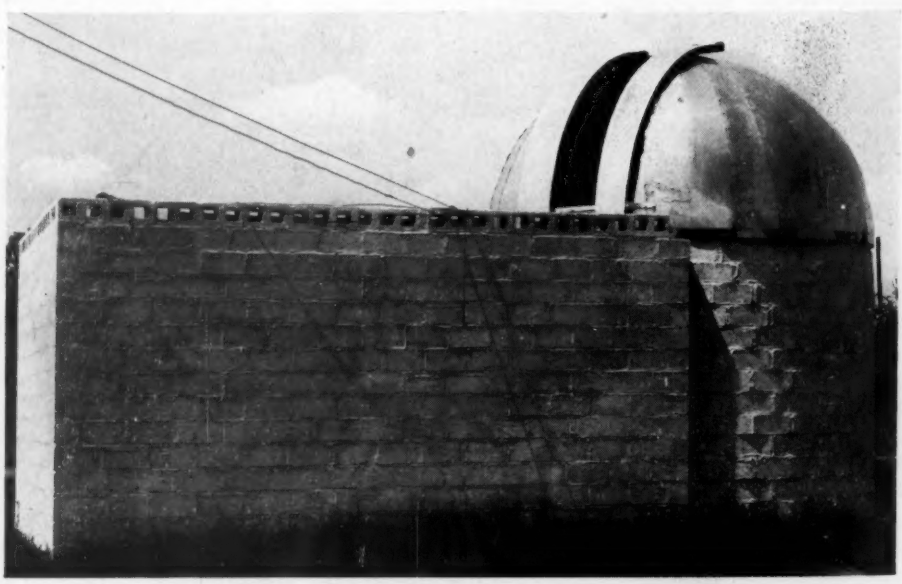


Rice Observatory's 12-inch Cassegrainian reflector beneath its slide-off roof.

Paul Linde, of Crossville, Tenn., an expert in the grinding and figuring of lenses and mirrors, made the barrel for the refractor and ground and figured the optics for both instruments. Construction and installation of the electrically operated dome was made by Haines Scientific Instruments, Englewood, N. J., and this company also constructed the 7-inch refractor mounting.

In the right wing of the Rice Observatory are 13 transparencies of various celestial objects made by the Hayden Planetarium in New York City. There is also a large composite view of the moon, made from Lick Observatory photographs published in *Sky and Telescope*. Also in this wing are 40 views of mythological constellation figures duplicated from the classic Bayer *Uranometria*.

G. FRANK BURNS, associate editor
The Democrat
Lebanon, Tenn.



The dome and slit of the 7-inch refractor, and at the left the room housing the reflecting telescope pictured above.

THIS MONTH'S MEETINGS

Chicago: "Photography of Double Stars" will be the topic of the lecture by Dr. K. Aa. Strand, of Dearborn Observatory, before the Burnham Astronomical Society on March 9th. The meeting will be at 8:00 p.m., at the Chicago Academy of Sciences.

Cleveland: Dr. Joel Stebbins, of the Washburn Observatory, will speak on "The Electric Eye in Astronomy" on March 19th at the Cleveland Astronomical Society meeting, which will be held at the Warner and Swasey Observatory at 8:00 p.m.

Detroit: On Sunday, March 14th, Dr. Carl A. Bauer, of the University of Michigan Observatory, will talk to the Detroit Astronomical Society on "The Age and Origin of Meteorites." The lecture is at 3 p.m. at Wayne University, Room 211.

Geneva, Ill.: The meeting of the Fox Valley Astronomical Society will be on Tuesday, March 2nd, at 8 o'clock in the Geneva City Hall. Carl Bast, of Batavia, will speak on "The Living Universe."

Indianapolis: A demonstration of the Spitz Planetarium is scheduled for the March 7th meeting of the Indiana Astronomical Society to be held at the Riley Library at 8 p.m. David M. Ludlum, of Science Associates, is the lecturer and demonstrator.

Madison: At the March 10th meeting of the Madison Astronomical Society, held at Washburn Observatory at 8 o'clock, E. P. Baillie, vice-president of the group, will lecture on "Galaxies."

Minneapolis: At the meeting of the Minneapolis Astronomy Club on Wednesday, March 3rd, Arthur T. Adams will speak on "Great Astronomers and Their Contributions to Science." The March 17th meeting will feature a book review by Waldemar Wuestneck of the book, **Between the Planets**, by F. G. Watson. Both meetings are at 7:30 p.m. at the Minneapolis Public Library.

New York: Dr. Wallace J. Eckert, of the International Business Machines Laboratories, will address the Amateur Astronomers Association at their March 3rd meeting, 8:00 p.m. in the American Museum of Natural History. His topic will be "Star Catalogues and Their Construction."

Philadelphia: The Rittenhouse Astronomical Society will hold its annual joint meeting with the Franklin Institute on Wednesday, March 3rd. The speaker will be Dr. J. J. Nassau, director of the Warner and Swasey Observatory, Case Institute of Technology; his subject is "Recent Problems of the Galaxy."

Pittsburgh: The speaker at the March meeting of the Amateur Astronomers Association of Pittsburgh will be M. Graham Netting, of the University of Pittsburgh and the Pittsburgh Carnegie Museum. His subject is "The Geography of Pittsburgh," and he will show Kodachrome slides. The meeting begins at 8:15 p.m., Friday, March 12th, in the Buhl Planetarium.

San Diego: On Friday, March 5th, Professor B. O. Lacey will speak on current events, and C. N. Pinco will tell of the "Astronomical Clocks of Europe," before the Astronomical Society of San Diego. The meeting is at 7:30 p.m. in the Gas and Electric building.

Washington: Franklin Kral and Leo W. Scott, of the National Bureau of Standards, speak before the National Capital Astronomers on Saturday, March 6th, at 8 p.m. in the National Museum. Their talk on "The 1947 Eclipse Expedition to Brazil" will be illustrated with motion pictures and lantern slides. Both speakers were members of the official party of the Army Air Forces-National Geographic Society expedition.

Northeast Regional Convention in Early April

Under the auspices of the Amateur Astronomical Society of New Haven, and on the invitation of Dr. Dirk Brouwer, director of Yale University Observatory, the 1948 convention of the Northeast region of the Astronomical League will be held in New Haven on Saturday, April 3rd. Amateurs will find the visit doubly worthwhile, for on Sunday, April 4th, the solar division of the AAVSO is holding a conclave at the Yale University Observatory.

Donald H. Kimball, regional chairman, has announced a meeting of the regional council for 7:30 p.m., Friday, and the following tentative program for Saturday:

9:30 a.m. Registration
10:00 a.m. Welcome by Dr. Brouwer, and business meeting
11:00 a.m. Panel on "Relationships Between the Region and the Societies"
12:15 p.m. Photograph and lunch
2:00 p.m. Guest speaker, probably on the theme of how amateurs can aid professional astronomers
3:00 p.m. Section meetings on instruments, observing, programs
4:15 p.m. Tea, followed by a tour of the observatory
6:30 p.m. Informal dinner
8:00 p.m. Observing (weather permitting)

For overnight accommodations write Donald H. Kimball, Yale Observatory, New Haven 11, Conn., by March 20th, enclosing payment. Rates per person are $3.00 for one night, $2.50 per night for two nights. Preference will be given those attending the solar division meeting on Sunday.

Rittenhouse Astronomical Society

Election of officers for the year 1948 was held by the Rittenhouse Astronomical Society at its January meeting. Edwin F. Bailey is now president of the Philadelphia group; Dr. Raymond H. Wilson, Jr., was elected vice-president. S. W. Johnson is serving as treasurer, and the secretary is Sarah Lee Lippincott. Member-at-large is Dr. John B. Irwin.

Indexes and Bound Volumes

All volumes of Sky and Telescope are fully indexed, and the indexes are available at 35 cents each postpaid. Send 35 cents in stamps or coin or include with your renewal check or money order. Bound volumes, at $6.50 each postpaid, are also now ready for Volumes II, IV, V, and VI.

SKY PUBLISHING CORPORATION

Los Angeles Astronomical Society

The headquarters and shop of this society are now located at the Griffith Observatory and Planetarium, in Griffith Park, Los Angeles. Monthly lecture meetings are held there on the second Tuesday of each month at 7:45. Informal meetings are held every Friday evening, and the shop is open to members and visitors to the society during the same hours the observatory is open to the public.

We have been most fortunate to have had exceedingly fine lectures during the past year. Outstanding men from the staff of the Mount Wilson Observatory and from the California Institute of Technology have spoken on various phases of astronomy. Members of the astronomical fraternity visiting Los Angeles are cordially invited to visit us.

H. L. FREEMAN
Secretary-treasurer, LAAS
Griffith Observatory

Minneapolis Astronomy Club

Activities of the Minneapolis club include lectures given throughout the season on astronomy and telescope making, and a number of field trips, either to someone's home where there is a telescope, or to a selected spot where we can stargaze to advantage. The group is a member of the Minneapolis Science Museum Society, with headquarters at the Public Library Museum.

A class in telescope making is sponsored each year by the club, starting in October and carrying through May. This group meets one night a week at the Public Library.

MRS. ALMA LJUNGREN, secretary
4054 Russell Ave., N.
Minneapolis 12, Minn.

Key West Officers

At our January meeting, at which there were 12 members present, J. P. Baillod was elected president; E. W. Stark, secretary and treasurer; and the writer, corresponding secretary.

While as very amateurish amateurs we have much to learn, our members are looking forward with enthusiasm to the new year's activities. There has already been a move to organize a junior club among the high school boys and girls. At our roll call, each member is asked to furnish some item of interest he has acquired between meetings. With Mars and Saturn back in the sky, our 8-inch reflector is particularly busy again. And beautiful Canopus rises high in the south, in mighty competition with Sirius.

W. M. WHITLEY
1307 Div. St.
Key West, Fla.

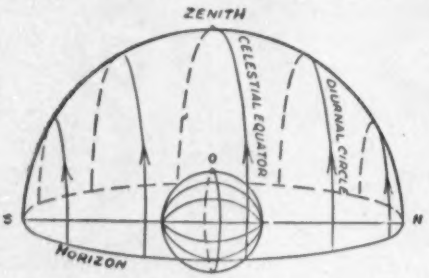
New York Society Plans Observing Weekend

The field trips committee of the Amateur Astronomers Association, New York, has announced a winter weekend at the Blue Mountain Trail Lodge, Peekskill, N. Y., where the society's annual Labor Day weekend is held. It is planned to use the lodge as headquarters for daytime winter sports and nighttime observing from Friday night to Sunday night, March 5th to 7th.

TERMINOLOGY TALKS- J. Hugh Pruett

Right Sphere

Many who have never carefully watched the stars rise, cross the sky, and set, seem of the opinion that these heavenly bodies come straight up all along the eastern horizon and, after reaching the meridian, drop directly down toward the western skyline. Such persons should live exactly on the equator, for there their non-observational theory would coincide perfectly with the facts. From the earth's equator, the celestial poles appear (disregarding slight refraction effects) to rest on the north and south points of the horizon, and the entire sphere of the starry skies, to all appearances firmly bound together, rotates westward as if resting on the polar pivots. (This seeming motion is, of course, a consequence of the earth's actual eastward rotation on its axis.)



The right sphere. From "Astronomy," by Robert H. Baker.

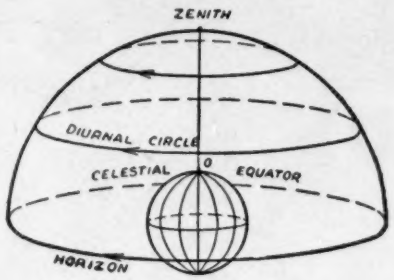
To an observer at the equator, celestial bodies in all parts of the heavens, sun, planets, and stars, are above the horizon approximately 12 hours on every day of the year. Long summer and short winter days are unknown in this region of monotonous day lengths. The celestial equator extends up from the eastern point of the horizon, passes through the zenith, and drops down to the west point. This arrangement of the celestial sphere where risings and settings are at right angles to the skyline is known as the *right sphere.*

Parallel Sphere

If an observer were stationed exactly at the earth's north pole, the celestial pole (about 1° from the North Star) would appear directly in the zenith, and the celestial equator would extend all around the horizon. Under these conditions stars do not rise and set at all. Those above the horizon remain above and complete daily circles parallel to it. Those nearly overhead make small diurnal circles around the zenith in a counterclockwise direction. (At the south pole, the direction is clockwise.)

Stars on the southern half of the celestial sphere are never seen from the earth's north pole. This arrangement in which the stars apparently move parallel to the horizon is known as the *parallel sphere.*

From the discussion last month it is easily noted that at the earth's poles, where the horizon and the celestial equator coincide, the ecliptic, apparent path of the sun among the stars, is constantly half above and half below the horizon. At the north pole, therefore, the sun rises once a year (about March 21st) — but at no definite point along the skyline — and takes up its daily circling nearly parallel to the horizon. Its sky path actually is a spiral. At the end of three months it reaches the highest point on the ecliptic, 23½° above the polar observer's horizon. Then for another three months it spirals downward, and about September 23rd disappears gradually, not to be seen for another six months. The ensuing "evening twilight" lasts for nearly two months, and is followed by the long polar night.



The parallel sphere. From "Astronomy," by Robert H. Baker.

In this frigid region, the continuous night is often illuminated by the moon, which rises about once a month and sets some two weeks later. At times the moon may reach an altitude of 28½° above the horizon; at other times years later it can attain only 18½°. The highest full moon occurs in December, when the sun is farthest below the horizon; except for refraction effects the full moon cannot be seen during the six months' day at the pole, but the gibbous phases may be observed with the sun in the sky.

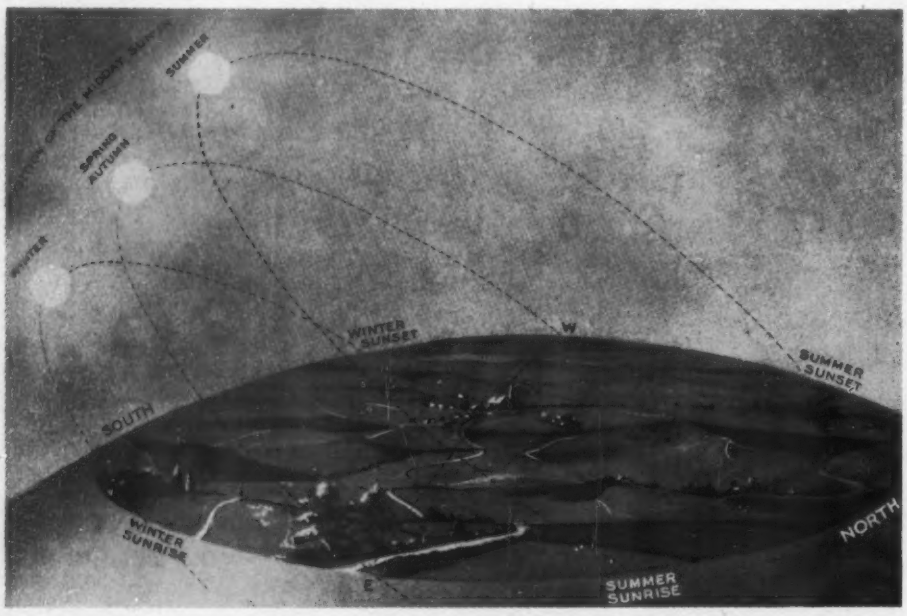
The planets also rise and set in conformance with their periods of revolution around the sun. Thus, were you stationed at the north pole, you would observe Jupiter in the sky continuously for six years at a time; Saturn for nearly 15 years; and Neptune for over 80 years. This last-mentioned planet is now south of the celestial equator, however, so it is invisible at the north pole of the earth.

Oblique Sphere

Between the earth's equator and poles, the stars seem to move neither at right angles nor parallel to the horizon. At a north latitude which we may call L°, the celestial pole appears L° above the north point of the horizon. Since the celestial equator is always 90° from the pole, it crosses the meridian L° south of the zenith (90° — L° above the south point of the horizon).

For example, at latitude 45° north, the celestial equator touches the horizon at the eastern point, slants upward toward the south at an angle of 45°, crosses the meridian 45° south of the zenith, strikes the western point of the skyline, and under the earth is 45° north of the nadir. As the illustration shows, this same description applies to the daily path of the sun on March 21st and September 23rd, when it is on the equator, and to any star located there.

(Continued on page 124)



The path of the sun at various seasons of the year, for an observer in the north temperate zone. This illustration of the oblique sphere is from "Splendour of the Heavens."

AMERICAN ASTRONOMERS REPORT

Here are highlights of some papers presented at the 78th meeting of the American Astronomical Society at McMillin Observatory in December. Complete abstracts will appear in the Astronomical Journal.

Meteors by Radar

UPPER ATMOSPHERE studies will benefit from combined radar, photographic, and visual observations of the Perseids, made jointly by the Dominion Observatory, Ottawa, and the National Research Council of Canada, in a program under the guidance of Dr. Peter M. Millman. He was assisted by D. W. R. McKinley and Miriam S. Burland. The apparatus was set up at the radio field station of the National Research Council of Canada, four miles south of Ottawa. A secondary visual and photographic station was operated at Luskville, Quebec, 22 miles distant.

In a total of 30 hours of observation on five nights, August 9-14, 1947, 3,700 radar echoes, 1,100 visual meteors, and 20 meteor photographs were recorded. In order to correlate the radar and photographic records with the actual meteors, six experienced observers scanned the sky and plotted the path of each meteor, with its time of appearance to the nearest second. The cameras took both direct photographs and spectra.

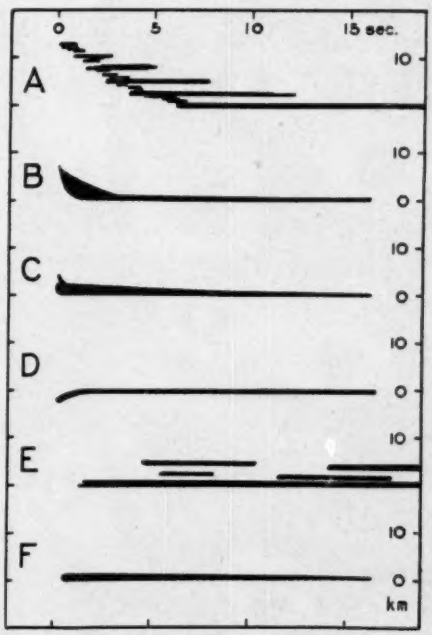
A total of 101 radar echoes with a duration of five seconds or longer coincided in time with the brightest visual Perseids, and Dr. Millman believes that not more than three of these coincidences could have happened by chance. But for 54 more of these brightest meteors there was no echo at all on the radar, which presents a puzzle. For radar echoes lasting less than five seconds, which were 12 times as numerous as the longer ones, there was no significant correlation with the visual meteors in time of appearance.

Theories to explain just how a radar echo bounces off the path of a meteor in space are still in a formative stage, but the Canadian astronomer suggests that some of the effects observed by radar may indicate that the upper atmosphere is definitely stratified, with thin layers of differing composition, temperature, and pressure lying above each other. As the descending meteor cuts through these layers, certain regions are ionized by its passage and make better "spots" for the reflection of a radar beam than do other regions. This theory may account for the missing radar echoes for 54 bright meteors.

The radar operated on 32.7 megacycles per second, with 150 kilowatts peak power, eight-microsecond pulse width, and receiver sensitivity of 5×10^{-14} watts. Both transmitter and receiver employed simple horizontal dipoles oriented north and south. An A-scope display was used for monitoring, while a range-time display on a long-delay-screen cathode-ray tube was used for recording and photographing the echoes.

Two kinds of echoes were recorded by the radar: one showed a continuous change in range, either increasing or decreasing, and appeared simultaneously with the visual meteor. But velocities deduced from this type of echo averaged well under the Perseid velocity of 61 kilometers per second. This first type of echo corresponds consistently with reflection from a meteor path length of about 20 kilometers.

The second type of echo is a long-enduring one at a definite range which appears after the visual meteor has been seen, with delays ranging from one to 12 seconds, and which is present for all meteors considered. The overall mean height for echoes of the second type was 99 kilometers, and the average height difference between two echoes from the same meteor was five kilometers. It is for echoes of this second type that the existence of discrete upper atmospheric layers is proposed.



Variation of range with time in Perseid radar echoes. Type A shows successively lower regions of ionization by an average meteor about 45 degrees from the radiant. Types B and C are about 73 degrees from the radiant, with ranges of about 140 and 132 kilometers respectively. The total change in range for type A is about 13 kilometers. Observations by the Dominion Observatory and Canada's National Research Council.

Minor Planet Tables

MOTIONS of minor planets present interesting problems because these bodies are small and they come close to the powerful major planet, Jupiter, which causes considerable perturbation of their ideally undisturbed orbits around the sun. The calculation of the disturbed path of an asteroid can be made by well-known classical methods, but these fail in a case where the ratio of the daily motion of Jupiter to the daily motion of the minor planet is approximately that of two small integers. The smaller the integers, the more complicated the problem becomes.

Sophia Levy McDonald, associate professor of mathematics at the University of California at Berkeley, described tables which have been developed to apply to the cases where asteroids have daily motions approximately twice that of Jupiter, the so-called asteroid Group 1/2. About one third of the known minor planets belong to this group. Her paper dealt with developments of general perturbations of minor planets of Group 1/2 with applications to 35 special cases. The numerical studies show that the range of usefulness of the Berkeley tables is appreciably greater than was expected when they were first published.

Reddening of Galaxies

FROM observations with a photomultiplier tube at the focus of the 100-inch telescope at Mount Wilson Observatory, Drs. Joel Stebbins and A. E. Whitford, of Washburn Observatory, have found that distant galaxies are distinctly redder than nearby ones. This reddening, which may be likened to an apparently lower average temperature of their constituent stars as we progress outward among the galaxies, is over and above the well-known red shift of the spectrum lines, and is several times greater than would be anticipated from that shift.

The newly found reddening is, however, proportional to the shift of the spectrum lines, and has been followed from the nearest examples, comparative neighbors of the Milky Way less than a million light-years distant, to a member of a cluster in Bootes more than 200 million light-years away.

It is the red shift in the spectra of galaxies which supplies the observational evidence for the theory of the expanding universe. The Bootes galaxy appears to have a velocity of recession of 24,000 miles per second, or 13 per cent of the velocity of light. The galaxy is

of the 18th magnitude, near the limit of what can be seen visually through the 100-inch telescope. In order to reach these faint objects with the photomultiplier cell, the tube was refrigerated with dry ice, thereby reducing its internal "noise" considerably. The colors of the galaxies were determined by measuring their relative brightnesses through yellow and blue filter glasses.

The cause of the reddening is not known. It has the effect of making the galaxies appear fainter to the photographic plate and many which could otherwise be photographed are thereby lost. One possible explanation, that space is not perfectly transparent and that the nebulae are more thickly distributed near the fringes of the explored region of the universe, is difficult to accept. In analogy to the reddening effects of dust particles between the stars in our own galaxy, the new effect might be ascribed to material between the exterior systems which would cause reddening of 0.5 magnitude in 70 million parsecs. The space involved is so vast, however, that such an assumption leads to a great increase in the total calculated amount of matter in the universe.

Whatever the cause of the reddening, it seems evident that the counts of faint nebulae and the inferences from them concerning the remote depths of the observable universe must be re-examined.

Orbit of Gamma Persei

THE THIRD-MAGNITUDE star Gamma Persei has long been known as a spectroscopic binary, both because of the shifting of its spectral lines and because its spectrum is composite, showing clearly that two stars of very different temperatures are present. However, its period was unknown. In 1932, at the University of Michigan Observatory, a record of the spectrum was obtained which showed an unusually great difference of speed of the two stars in their orbital motion. Since then many observations have been made, but it was not until early in 1947 that the large difference recurred.

Dr. Dean B. McLaughlin has combined the 15-year Michigan series with published observations from other observatories (some dating back to 1897) to obtain the orbital and physical characteristics of the two stars. One is a giant with a surface temperature of 5,700° absolute, a mass 4.7 times the sun's, diameter 12 times and brightness about 100 times that of the sun. It is almost a twin of the brightest member of the spectroscopic binary Capella. The other star closely resembles the apparently brightest star in the sky, Sirius, with a temperature of 11,000°, mass 2.7, diameter 1.8, and brightness 25 times the sun's.

The relative orbit of the two stars is a long ellipse with its plane nearly edgewise toward the earth and its longer dimension at right angles to the line of sight. The period of revolution of the stars is 14 years, eight months. When closest together, as the stars were in March, 1947, they are 3.3 times as far apart as the earth and the sun, and passing each other at a relative speed of 37 miles per second. When farthest apart, as they were in November, 1939, and will be in July, 1954, they are separated by 20 astronomical units, or the radius of Uranus' orbit; their relative speed is only 6.6 miles per second.

The separation of these stars throughout 1954 will be great enough so that it should be easily possible to see them as individuals in a telescope of moderate size. Thus, the system will be a visual as well as a spectroscopic binary. Their distance from the sun is estimated at 160 light-years, but when they are actually seen resolved in 1954 an accurate measurement of their angular separation, combined with the spectroscopically determined orbit, should give a reliable determination of their distance from us.

Surface Patches on a Star

DURING the past nine years, the eclipsing variable AR Lacertae has been observed with a photoelectric photometer at the Lick Observatory. Five light curves, representing the years 1938, '39, '40, '46, and '47, were obtained, and confirm the discovery by F. B. Wood that the smaller component of this double star is intrinsically variable, with an amplitude of about 20 per cent of the light of the smaller star.

Dr. G. E. Kron now interprets the intrinsic variability as caused by the formation and dissolution of bright and dark surface patches on the smaller component. These patches appear and disappear around the limb of the star with rotation of the binary, and they have been observed to be occulted by the larger star during partial phases of the eclipse. The patches seem to move slowly along the surface of the star. They form suddenly, within a few days, and last from three to six weeks. Their dissolution is slower than their formation.

Anticenter Data

OUR SUN has long been known to be located in the outer reaches of the Milky Way system. Its distance from the center of the galaxy is approximately 35,000 light-years. Astronomers have generally assumed that the system stretches for another 15 to 20 thousand light-years beyond the sun. Dr. Bart J. Bok, of Harvard College Observatory, described a study, in collaboration with B. Boutelle and M. Olmsted, of the stellar distribution for the section of the Milky Way opposite to the direction of the center.

He found that overlying the anticenter region is a veil of obscuration of variable density. In the thinnest parts, this veil produces a dimming of one magnitude in the light of stars at 5,000 light-years from the sun, whereas in the thickest part the dimming may be fully three magnitudes.

Spectral data indicate that at a distance of 3,000 light-years the stars appear to have thinned out to one half the density for the region of the galaxy surrounding the sun. A careful search for remote objects in the anticenter section reveals none for which the distance can be said, with some degree of confidence, to be greater than 10,000 light-years. Further exploration for faint clusters and variable stars is highly desirable, but Dr. Bok believes we must consider the possibility that the effective boundary of the Milky Way system is at 10 rather than 15 or 20 thousand light-years beyond the sun.

TERMINOLOGY TALKS

(Continued from page 122)

Inasmuch as all stars appear to rise and set along paths parallel to the celestial equator, those south of that dividing line achieve less altitude on the meridian and have short paths above the horizon, illustrated in the picture by the sun's path at the winter solstice. But stars north of the equator have long paths, as does the sun in spring and summer, and in the case of stars within 45° of the pole (in our example), these paths are completely above the horizon. Thus, at latitude 45° north, stars more than 45° north of the celestial equator never set, but, as a compensation, those south of the equator by 45° or more never rise. Those between these limits are in the sky from practically 24 hours to less than a minute depending upon their locations.

Another example might place the observer at 30° latitude north of the equator. The celestial pole is then 30° above the horizon, and stars more than 60° north of the celestial equator are circumpolar. The equator runs between the east and west points of the horizon through a point on the meridian 30° south of the zenith or 60° above the south point of the horizon. Stars within 30° of the south celestial pole never rise. Similar examples may be made up for other latitudes.

HUBBLE AND PALOMAR

Time magazine for February 9th features Mount Wilson astronomer Edwin P. Hubble and his plans for extragalactic research with the 200-inch telescope. An explanation of the expanding universe and associated theories is given, along with information on Dr. Hubble's personal achievements and the construction of the observatory on Palomar Mountain.

More About the Great Comet

SEVERAL REPORTS and photographs of Comet 1947n have been received since the February issue, containing the bulk of this material, went to press.

Douglas C. Berry, director of the comet section of the New Zealand Astronomical Society, states that the comet was distinctly pinkish to the naked eye, although this coloring was not so pronounced in his 3½-inch refractor. Bad weather interfered with his observations, but he did obtain a picture on December 12th, when he estimated the comet's brightness as between 1st and 2nd magnitude. His picture shows the nucleus and the principal tail. The camera was a 6-inch Dallmeyer rapid rectilinear of 52 inches focus.

Via the Australian News and Information Bureau, we have received a picture quite similar to Mr. Berry's and taken at the Commonwealth Solar Observatory, Mt. Stromlo, Canberra, Australia. Dr. Richard Woolley is quoted as estimating the tail of the comet on December 15th as 10 million miles long.

Two excellent photographs were sent by Dr. Jorge Bobone, director of Cordoba Observatory in Argentina, one of them reproduced on this page. In his report, Dr. Bobone states that the first news of the comet came by telegram on the morning of December 9th; this message was from the Observatory of Cosmic Physics at San Miguel, Buenos Aires, where the comet had been seen the preceding night. The Cordoba staff observed the celestial visitor easily that evening, and photographic work was begun at once for both position and physical study of the comet.

"On December 9th," writes Dr. Bobone, "the comet had a bright nucleus of apparent magnitude about 2, and the tail extended for about 20 degrees. On the following days the comet became fainter and fainter. At our astrophysical station in Bosque Alegre, Dr. Jorge Sahade took on December 11th and 12th two spectrograms with 45 and 59 minutes exposure, respectively, using the Wood grating spectrograph attached to the 60-inch reflecting telescope, dispersion 40 angstroms per millimeter."

The preliminary parabolic orbit computed by Dr. Bobone was mentioned last month, and his elements and ephemeris published on a Harvard Announcement Card.

From I. L. Thomsen, director of Carter Observatory, Wellington, N.Z., two pictures have been received and an account throwing considerable light on the mystery of who discovered this comet first. He writes, in part:

"As far as New Zealand is concerned, the first information was received at the Carter Observatory on the morning of December 10th, from the Naval Signal Distributing Office in the form of the following message: 'Bright comet observed bearing 14° 10'.5 south of Venus, altitude 4° 37', true bearing on Venus 242°, latitude 36° 47' south, longitude 162° east, time of observation 090945Z. HMNZS *Arbutus.*'

"From this information the position of the comet was computed as $18^h\ 6^m$, $-35°\ 16'$, on December 9th at 9:45 (a.m.) GCT. It will be found that this is close to the ephemeris position computed from Dr. L. E. Cunningham's first parabolic orbit. Unfortunately, when the calculation was first made, an error occurred and the right ascension was given as $18^h\ 28^m$. The only excuse to be offered is that during the work telegrams and letters began to arrive from other observers, and the telephone began to work overtime.

"It has been suggested that, unless there are stronger claims from South Africa, South America, or Australia, the comet be given the name of 'Arbutus' in view of the fact that this ship not only gave an early report but also a fairly accurate position of the comet's nucleus.

A very early picture of Comet 1947n, taken December 9th by Dr. J. Bobone.

"There were undoubtedly other observations made on the same night, and already many of these have been collected at the Carter Observatory. The principal observations were made by meteorological officers in various parts of New Zealand with pilot balloon theodolites, and by the ships SS *Waipori* and SS *Kaimai.* Reliable newspaper evidence indicates that residents of the west coast of the South Island of New Zealand saw the comet on December 8th, but as to the names of individuals and the times of observation there is no record. It appears that everybody thought that such an obvious object was probably already well known to astronomers and there was no need to make a special report. General cloudy conditions prevailed over New Zealand, except on the west coast, for the first nine days of December, after which a very fine spell was experienced.

"On the afternoon of December 10th I had the thrilling experience of receiving a radio-telephone call from Dr. Cunningham, at the Students' Observatory, Berkeley, California. Dr. Cunningham had proved himself our good friend in the case of Comet Jones, and it was delightful to be able to speak to him. Eventually, positions of the comet as observed at Wellington on subsequent days through the 15th were cabled to Dr. Cunningham, and on the 18th, only 10 days after discovery, the elements of a parabolic orbit were received from him.

"Reports from many amateur observers have already been collected at the Carter Observatory with the prospect of more to come. All observations, especially for the first few nights, were hindered by the long twilight, the very low altitude of the comet, and passing clouds. It seemed impossible to see nearby faint stars for differential work, so I made observations for position with the circles of a 5-inch equatorial refractor belonging to the Wellington Branch of the Royal Society of New Zealand. This was done with some trepidation, for I have never forgotten how the late Dr. A. C. D. Crommelin in a kindly manner hinted that circle readings I had made of Comet Encke in 1931 were all right in a way, but it would have been better to have made differential measures. Position observations of varying degrees of accuracy have been made at Wellington, Dunedin, Wanganui, Christchurch, Auckland, and New Plymouth. A. Jones, discoverer of Comet Jones, has sent in some very carefully made field drawings which may prove very useful after reduction.

"As for brightness, when one commences to make an estimate of the nucleus and coma combined the difficulties

(Continued on page 136)

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BOOKS AND THE SKY

SUNSPOTS IN ACTION

Harlan True Stetson. Ronald Press Company, New York, 1947. 252 pages. $3.50.

IN 1843, after nearly a quarter century of careful daily observation of the sun, Samuel Heinrich Schwabe announced the discovery of the cycle in sunspot activity. Briefly, he found that the number of sunspots increases and decreases in a fairly regular fashion with a period of approximately 11 years. By now the fact of this sunspot cycle has become so familiar to us that we are apt to overlook its truly spectacular nature. When we stop to contemplate the grand scale of sunspot activity and the enormous quantities of energy involved, we renew our sense of humility and wonder in the face of cosmic forces.

More than a century has elapsed since Schwabe's discovery, during which vast quantities of data have been accumulated by many enthusiastic investigators. The methods of spectroscopy have been developed and vigorously exploited. We have learned much about the chemical composition and physical state of the surface layers of the sun, and the prominences and corona. But nearly all our knowledge is purely descriptive — we can describe the parts of the sun which we can see. The 11-year cycle seems to pop up in almost any solar feature that can be observed, but so far there is no satisfactory theory of the mechanism behind the cycle and the fact that so many apparently unrelated phenomena share in it.

In the latter part of the 19th century a strong positive correlation was discovered between the number and size of the sunspots and the occurrence of disturbances in the intensity and direction of the earth's magnetic field. In general, magnetic disturbances increase with the sunspots. Frequently the meridian passage of a particularly large and active sunspot coincides with a violent magnetic disturbance. Since this initial discovery in the science of solar-terrestrial relations, close examination of other phenomena of the earth's atmosphere has revealed a whole family of things which seem to be affected by sunspots.

In his new book, **Sunspots in Action,** Dr. Stetson presents a very readable and comprehensive discussion of the whole field of solar-terrestrial relations. He reviews briefly the present state of our knowledge of the sun itself, but most of the space is devoted to a study of the more subtle effects of the sun on the earth and its atmosphere and is copiously illustrated with diagrams and graphs of the observed relations. His effort to make the subject clear to the uninitiated lay reader is highly successful, and no one need hesitate to read this interesting book for fear it is too technical.

While most of the explanations are excellent, the details of a few are not entirely clear. For instance, changes in the earth's magnetic field are attributed to changes in ionization in the upper atmosphere. The idea is that the ionized molecules, circulated around the earth's axis by diurnal rotation, constitute an electric current which creates a magnetic field, the strength of which depends upon the extent of ionization. But, on the face of it, this is not true unless something more than ionization takes place. Although the air may be highly ionized, it is not **charged** unless the positive and negative ions are systematically separated in some fashion, and it is the circulation of an electric **charge** that constitutes an electric current capable of producing magnetic effects. In view of the potential gradients which probably exist in the upper atmosphere, it is not unlikely that some vertical separation of positive and negative ions does take place and some magnetic effect might be expected. But one could legitimately ask whether the order of magnitude of the effect corresponds to the observed disturbances of the earth's field, and Dr. Stetson's failure to discuss this aspect of the problem may be a little puzzling to some readers.

Throughout the book the solar-terrestrial effects are attributed to two types of emanations from sunspots, ultraviolet radiation and showers of high-velocity particles which are probably charged. These emanations impinge on the molecules of the upper atmosphere of the earth. The primary result is a fluctuation in the ionization of the atmosphere. Changes in atmospheric ionization are manifested in many ways which are explained in some detail. The most conspicuous effects are found in radio disturbances, magnetic storms, and auroral displays. Although the author does not explicitly say so, the principal evidence for the existence and nature of the solar emanations is simply the occurrence of the radio disturbances, magnetic storms, and auroral displays.

The discussion of radio disturbances is particularly interesting. Dr. Stetson explains the nature of radio transmission and the dependence of long-distance reception on reflection of the radio waves from the ionosphere. The ionosphere consists mainly of two ionized layers in the atmosphere. They are the E and F layers; the height and degree of ionization of each of these layers depend upon the amount of ultraviolet radiation and high-velocity particles received from the sun. They vary widely between night and day, and are subject to violent disturbances when sunspots produce abnormal quantities of their emanations. As the ionization varies, the absorptive and reflective powers of the E and F layers vary. The variation is different for different radio frequencies. Hence,

NEW BOOKS RECEIVED

ELEMENTARY NUCLEAR THEORY, *H. A. Bethe,* 1947, *Wiley.* 147 pages. $2.50.

In a course originally given to engineers and scientists at the research laboratory of the General Electric Company, Cornell's leading physicist stresses the behavior of the simplest nuclear systems. Fission theory is omitted as being an applied rather than a fundamental aspect of nuclear physics.

FUNDAMENTALS OF PHOTOGRAPHIC THEORY, *James and Higgins,* 1948, *Wiley.* 286 pages. $3.50.

An account of the science of the photographic process discusses the physical and chemical reactions on which picture making depends. Some basic knowledge of physics is presupposed by the authors.

under given conditions, certain bands of the radio spectrum can be used effectively for long-distance transmission while other frequencies cannot be used at all.

The description of the highly ingenious methods used to determine the condition of the ionosphere is one of the strong points of this book. The author gives a great deal of incidental information about the great industry of radio transmission and the work of the Federal Communications Commission. He rightly remarks that here, at least, is a sizable block of our economic life which is directly and vitally influenced by the sunspot cycle.

In addition to the undoubted relation between sunspots and radio, geomagnetism and the aurora, the author gives considerable space to more speculative effects, ranging from the growth of trees and the weather to human psychology and the state of the stock market. The discussion is extremely entertaining and suggestive, although in most cases it is a record of frustrations in attempts to establish definite correlations.

The section on the work of Professor A. E. Douglass, of the University of Arizona, on the chronology of tree rings and their relation to the sunspot cycle is a high point of the book. It will be welcomed by readers like this reviewer whose knowledge of this research has been only fragmentary or nonexistent. Professor Douglass has established a definite connection between the sunspot cycle and the rate of tree growth indicated by the spacing of annual rings. The obvious conclusion is that there is a simple connection between weather conditions and the sunspot cycle. Yet attempts to establish such a connection directly have, at best, been inconclusive. Should we then conclude that the sunspots influence tree growth by some more direct mechanism than through effects on the weather? The answer cannot be given now.

One assumption implicit in most of the discussion in **Sunspots in Action** will meet with objection from many solar investigators. Dr. Stetson gives the impression that the periodic increase and decrease of the spottedness of the sun is a more-or-less isolated phenomenon of a primary nature, and that the solar-terrestrial effects are largely the result of activity of the sunspots themselves. Many solar features share the same periodicity in frequency and intensity. These include flocculi, faculae, prominences, and the corona. With the exception of the faculae, none of these appears to be closely related to the sunspots. It is generally believed, therefore, that the cycle of the spots is only one of many manifestations of a far more deep-seated cyclic rhythm in the interior of the sun. Dr. Stetson doubtless realizes this probability but fails to state it clearly. In doing so he also does not point out the possibility that the sunspots themselves may not be the actual source of the emanations which affect the earth, but simply highly probable concomitants along with other observable solar phenomena. He rightly emphasizes, however, the prime importance of further solar research without which we can never obtain a true understanding of the ultimate cause of the solar-terrestrial effects.

For the benefit of the reader who wishes to pursue the subject further, an excellent appendix has been included, containing a bibliography for each chapter and a table of the Zürich relative sunspot numbers by the month and year from 1749 to 1947.

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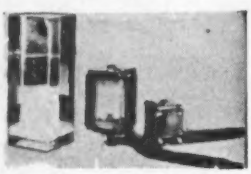

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GLEANINGS FOR A. T. M.s

Characteristics of Many Kinds of Eyepieces

JOHN HOLEMAN, of Richland, Wash., has furnished the following very interesting table and notes concerning a number of the eyepieces which are now available to the amateur. His tests have certainly been very thorough, and he has apparently rather well covered the many varieties of oculars now on the market. ATM's should find his data of value in selecting eyepieces for their own use.

We are publishing Mr. Holeman's data as received, and cannot, of course, guarantee the accuracy of his results. Some of the testing methods he has employed, especially in connection with distortion and astigmatism, may be open to criticism, but we do not wish to raise technical objection to what is, in our opinion, a comprehensive and much-needed study. The results certainly can be relied upon to disclose the **relative merits** of the eyepieces in question when used with a telescope of the focal ratio which Mr. Holeman employed in the tests.

Those most interested in reflecting telescopes should bear in mind that reflectors (exclusive of their eyepieces) are completely free of chromatic aberration, while

No.	*Maker*	*F.L.* (")	*A.F.* (°)	*E.R.* (")	*Dis.*	*A.*	*Def.*	*C.*	*T.*	*E.L.D.* (")	*F.L.D.* (")	*Remarks*
1	Mellish	0.24	38	0.03	MP	MT	F	N	R	0.18	0.30	0.25", for tel.
2	B & L	0.29	35	0.12	N	VS	G	N	O	0.25	0.25	5/16", for tel.
3	Mogey	0.31	35	0.00	MP	MT	F	N	H	0.16	0.37	1/5", for tel.
4	Kennedy	0.31	38	0.18	MP	MT	F	N	*	0.22	0.33	for refractor
5	Zeiss	0.35	40	0.19	N	N	E	N	O	0.31	0.31	9 millimeters
6	Bardou	*	32	0.15	SP	*	*	*	H	0.20	0.65	variable power
7	Dietzgen	0.50	29	0.13	N	N	E	N	T	0.16	0.30	survey level
8	Leitz	0.60	45	0.10	N	VST	G	N	*	0.25	0.58	microscope 15x
9	Wollensak	0.62	55	0.12	SP	MT	GC	E	K	0.50	0.69	8 x 30 binoc.
10	B & L	0.65	38	0.18	N	N	EC	N	O	0.50	0.50	1M range finder
11	Brandon	0.69	49	0.28	MP	ST	G	E	R	0.30	0.75	for reflector
12	unknown	0.70	35	0.50	SP	N	G	N	O	0.51	0.51	Edmund #6196
13	unknown	0.70	43	0.50	SP	T	G	N	S	0.75	0.75	Ballantyne #21
14	Goerz	0.70	42	0.62	VSP	N	E	N	S	0.68	0.68	4x panoramic
15	Gaertner	0.72	31	0.25	SP	N	G	E	R	0.30	0.50	marked 14x
16	B & L	0.80	43	0.75	N	VST	E	E	O	0.87	0.87	height finder
17	Spencer	0.90	35	0.13	N	N	G	N	H	0.37	0.81	microscope
18	Kollmorgen	0.90	50	0.75	MP	T	E	N	S	0.90	0.90	1"
19	homemade	0.91	59	0.38	MP	MT	GC	N	K	0.62	1.00	made by writer
20	Leitz	0.91	65	0.37	VSP	*	EC	N	*	1.05	1.50	10 x 80 binoc.
21	Square D	0.96	53	*	SP	ST	EC	N	K	0.62	1.00	7 x 50 binoc.
22	homemade	1.13	28	1.20	MP	VMB	GC	E	*	0.50		single lens
23	Wollensak	1.13	40	0.50	N	TSR	G	E	K	0.68	0.87	6x BC scope
24	unknown	1.20	70	0.62	SP	*	G	S	E	1.50	1.75	Harry Ross
25	Chinese	1.20	60	0.50	SP	VST	E	N	E	0.75	1.30	20 x 125 binoc.
26	unknown	1.28	65	*	SP	MB	EC	E	E	2.00	2.25	M71 telescope
27	K & E	1.36	56	1.00	SP	TSR	EC	N	E	2.25	2.25	8x elbow scope
28	Hensoldt	1.37	30	1.50	N	N	E	N	S	1.44	1.44	4x rifle scope
29	unknown	1.38	49	1.00	SP	T	G	E	S	1.13	1.13	Jaegers #57
30	B & L	1.38	70	0.87	MP	MTR	FC	E	*	2.00	2.62	sighting station
31	Japanese	1.41	44	0.75	VSP	VST	G	E	O	1.18	1.18	range finder
32	M.H.R.	2.00	40	1.12	N	VS	E	N	*	0.92	1.44	Navy scope
33	Kollmorgen	2.04	32	1.25	SP	N	E	N	K	1.00	1.15	2"
34	E. K. Co.	2.17	50	2.37	MP	MTR	GC	E	*	2.00	2.00	M53 A1 scope
35	unknown	4.50	36	4.10	N	N	G	S	E	2.87	3.18	tank scope
36	unknown	4.80	28	6.20	VSP	VST	G	N	P	2.90	3.00	Jaegers #74

NOTES AND ABBREVIATIONS

Distortion: MP, much pincushion; *N*, none; *SP*, some pincushion; *VSP*, very slight pincushion.
Astigmatism: MT, much tangential; *N*, none; *R*, radial; *ST*, slight tangential; *T*, tangential; *TSR*, tangential and some radial; *VMB*, very much both; *VS*, very slight.
Definition: E, excellent; *EC*, excellent in center; *F*, fair; *G*, good; *GC*, good in center only.
Chromatism: E, edges only; *N*, none; *S*, some all over.

Type: Explained in text or in notes below.

No. 4: Solid ocular type. Thick field lens with thin cap cemented on.

No. 6: F. L. variable by separating lenses in sliding tube; varies from 0.43" to 1.14". Astigmatism, definition, and chromatism vary with focal length. Made for a 2½-inch refractor.

No. 8: Periplan variety of Huygenian.

No. 20: No astigmatism except at extreme edges; least of any wide-angle ocular tested. Latest Erfle type with eye lens concave toward eye giving unusual seeing comfort.

No. 21: E.R. as mounted 0.12"; remounted 0.50".

No. 22: Plano-convex lens, flat side toward eye.

No. 24: Astigmatism at edges only.

No. 26: E.R. as mounted 0.75"; remounted 1.00".

No. 30: Bertele type with eye achromat, plano-convex field and center lenses.

No. 32: Modified Kellner, achromatic field lens.

No. 34: Variety of periscope type.

refractors are not. Consequently, the chromatic performance of a given eyepiece may be quite different with a reflector than with a refractor, such as used by Mr. Holeman.

THE INFORMATION in the table accompanying this report was obtained in a survey of oculars in the writer's possession. The data is presented to show the great variety of possible eyepiece types and their respective merits when used with an f/10 astronomical refractor. Abbreviations condense the data as much as possible for publication.

It is well known that for best performance an ocular should be designed for the objective with which it is to be used. Many of the eyepieces included in the table were made for other purposes than astronomical telescopes, and any lack of perfection is not a reflection on the maker, but on the application to which the product has been put. Some eyepieces, for example, were designed to be used with special erector systems which balanced the corrections, and when used without them the oculars may appear uncorrected. Binocular eyepieces are designed for objectives as short as f/3.5 in prism systems, and they cannot be expected to give the same results with long-focus lenses. In no case is there any intention to discredit any sample, but to demonstrate the great variety of eyepiece characteristics that is available.

John Holeman and his homemade 6-inch refractor. The mounting is temporary for the telescope is normally used for testing purposes indoors, where it is placed in a long air-conditioned gallery. Mr. Holeman believes he has one of the largest private collections of oculars ever assembled.

Explanation of Columns

Focal Length (F.L.) is probably the most important property of an eyepiece since it determines the magnification of the instrument. For telescope work about one inch focus is considered average for an eyepiece. In this table, focal length was determined by measuring the diameter of the Ramsden disk with a dynameter and calculating the focal length from the known diameter and focal length of the objective.

Angular Field (A.F.) is given in the table in degrees, and is the measure of the apparent field of view. The larger this factor becomes, the more area can be seen through the eyepiece. About 45° is average for a telescope ocular, although for microscope eyepieces the field may be as small as 28°. Anything over 50° is a wide-field eyepiece, and above 60° is unusual. Angular field is easily measured by finding the real field at a known distance and dividing by the instrument magnification to get the apparent field.

Eye Relief (E.R.) in this table, at least, is defined as the distance between the Ramsden disk and the closest part of the lens mounting. It is approximately the position of the eye for best seeing through that particular ocular. Less than 0.1 inch is uncomfortable, and wearers of eye glasses usually need 0.2 inch or more, but up to about an inch of eye relief is very desirable. This kind of eye relief can be measured by pointing the telescope, focused for infinity, at the daytime sky, picking up the bright projected image of the objective (Ramsden disk) on a piece of ground glass, and measuring its distance from the closest part of the ocular mounting.

Distortion (Dis.) is the warping of the image that takes place in most eyepieces. The most common effect is that a true square seen through an ocular will have its sides appear to sag inward, in what is called pincushion distortion. Some rare systems make a square appear to bulge outward, in barrel distortion. Distortion was studied by me by using the ocular as a camera lens and photographing a square grid of lines, enlarging the photograph, and comparing its distorted image with the original grid.

Astigmatism (A.) is the defect of an optical system that makes fine parallel lines appear to blur at some angles. Almost all oculars have some tangential

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astigmatism — fine lines tangent to the perimeter of the field are not well resolved. Less common is radial astigmatism, which shows itself as blurring of fine detail parallel to a diameter of the field. Either kind of astigmatism detracts from the appearance of the image, and large amounts of either or combinations of both make very poor observing. Of course, it is much more difficult to eliminate this effect from wide-angle oculars, and this should be taken into account when judging them. Astigmatism was measured by using the ocular as a photographic lens and photographing National Bureau of Standards resolution charts, followed by microscopic examination of the negatives as described in their report, "A Simple Method for Measuring the Resolution of Photographic Lenses."

Definition (Def.) is used here to express the quality of the image. Lack of definition may be due to any of the aberrations mentioned or to others not considered. Excellent definition means that the image looks perfect to the eye, as clear and sharp as the object itself would look at the same apparent distance.

Chromatism (C.) is a term used to lump all the effects of chromatic aberrations. The result of chromatism is to produce colored fringes around parts of the image. In this data, chromatism was roughly estimated by the eye while examining a test chart containing black, white, red, and green lines. If no colored fringes could be seen, serious chromatism was considered to be absent.

Type (T.) describes the lens arrangement of the ocular. Standard types are taken from Bell's **The Telescope. R,** Ramsden; **O,** orthoscopic; **H,** Huygenian: **T,** terrestrial; **K,** Kellner; **S,** Steinheil or symmetrical. Not included in Bell's book are two types, **P,** periscopic, which consists of a single eye lens and an achromatic meniscus field lens, and **E,** Erfle, which is a variable design with at least four major types, but always consisting of an eye lens, center lens, and field lenses, all of which may or may not be achromatic.

Eye Lens Diameter (E.L.D.) and **Field Lens Diameter (F.L.D.)** will give the reader an idea of the size of the lenses and the possibilities of remounting them. For instance, lenses larger than 1¼ inch could never be mounted for use in an eyepiece holder made for standard diameter 1¼-inch oculars. [See David W. Rosebrugh, "Remodeling Old Telescopes," **Sky and Telescope,** VI, 8, 16, June, 1947.]

It is easy to make your own comparisons and to estimate the performance of your own oculars from those shown in the table. The single lens, No. 22, is included to show how poorly a single lens functions.

The writer is an amateur telescope maker and has tested more than a hundred different kinds of oculars. He will be glad to trade information on them with other interested readers.

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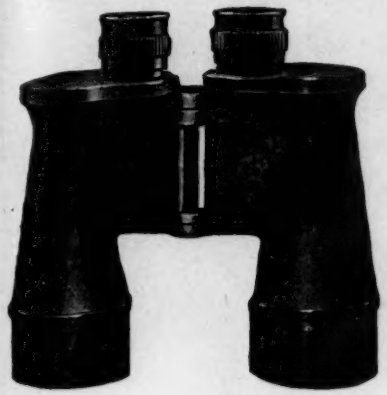

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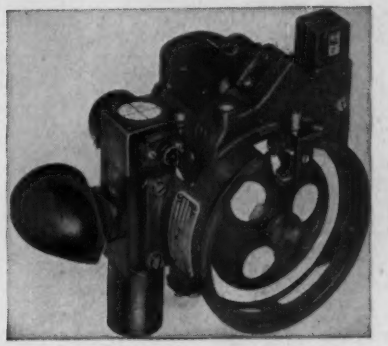

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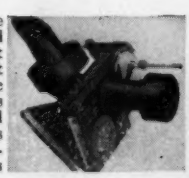

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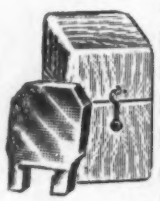

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OBSERVER'S PAGE

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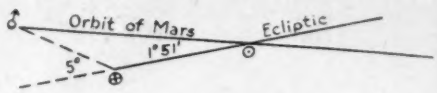
Occultations of Mars in 1948 and Reports of the January Conjunction-Occultation

THESE winter occultations of Mars were extraordinary ones which took place as a result of the earth's close approach to the planet at the time of opposition. Most planets move around the zodiac in such paths that their mean positions are very near the ecliptic. Occultation seasons occur when the planet is near the moon's nodes just as do those of solar and lunar eclipses. At other times the moon usually passes north or south of the planet at conjunction, and no occultation is visible. Near the times of opposition or inferior conjunction, however, because of the proximity of the earth and the planet, the geocentric position of the planet may depart considerably from the ecliptic so that an occultation is possible midway between the moon's nodes.

The situation for this synodic revolution of Mars is illustrated in the accompanying diagram, in which the horizontal scale represents the longitude of Mars and the moon at the time of each conjunction, while the vertical scale gives their corresponding latitudes. Points on the Martian curve are plotted for each conjunction of the planet and the moon from May 18, 1947, through November 3, 1948, and labeled with a triangle. On each side of and parallel to the lunar curve are two similar ones which indicate the limits of the zone within which all stars or planets are occulted from some point on the earth as a result of the moon's diameter and parallax. Occultations of those objects south of the path of the moon's center are more favorably observed in the Northern Hemisphere, while the others are best seen in the Southern Hemisphere.

As the chart shows, in June and July of 1947 there were two occultations of Mars near the moon's ascending node — where the sun had been totally eclipsed on May 20th. One of these occultations was favorably observed in each hemisphere. Similar occultations at the descending node take place late in 1948, with the one on September 6th visible in this country.

The moon's orbit around the earth is inclined to the plane of the ecliptic by 5° 9′ on the average, so that midway between the nodes the moon may be that far from the ecliptic. The orbit of Mars, however, is inclined only 1° 51′ to the plane of the ecliptic, and as seen from the sun this represents its greatest possible departure from the ecliptic in the sky. But the **geocentric** latitude of Mars may be considerably greater than this near times of opposition when the planet happens to be far from its own nodes, as shown in the small diagram. Fortunately, in 1948, Mars reached its greatest heliocentric latitude north on January 28th, only 20 days before the date of opposition, when the earth and Mars were their least distance apart. The result was that Mars' retrograde loop carried it apparently northward

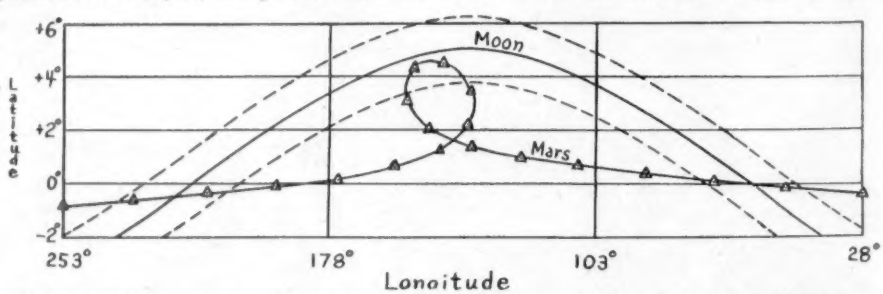


The relation of the earth and Mars when the planet may attain a considerable geocentric latitude. From left to right, the symbols mark the positions of Mars, the earth, and the sun.

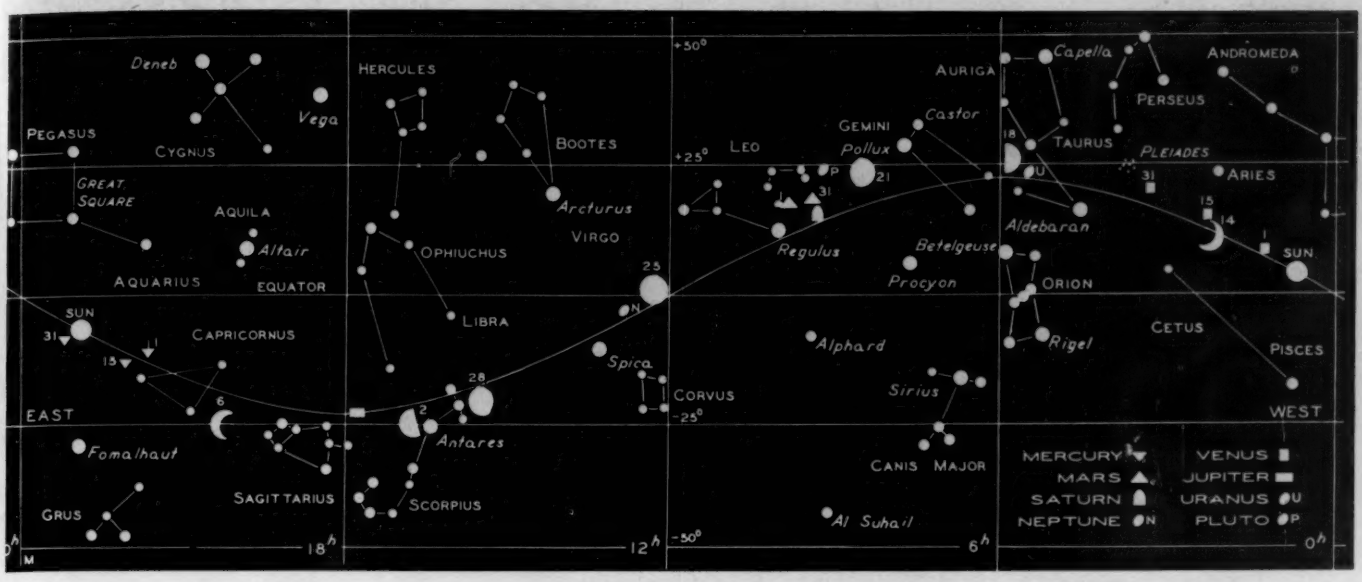
in the sky into the moon's "occultation" path for the pair of similar occultations which took place on January 27-28 and February 23-24, observable well up in the Northern Hemisphere of the earth.

There are many varieties of these circumstances of unusual occultations which change with the positions of the moon and planets in their orbits, and the gamut is far wider in the case of Mars than in any other. For example, there is a period near opposition during the summer months when no occultation of Mars is ever possible regardless of the distance the moon is from the ecliptic. This is because the planet at such times is near both its perihelion and its greatest heliocentric latitude south, so that it appears **too far** from the ecliptic for even the moon. This is just about the opposite to the condition discussed in this article. The interested reader may care to review in his **Ephemeris** the circumstances of the long series of occultations of Mars in 1945, of which two were visible in the northeastern states, and the solitary occultation of April, 1946.

At Rochester, the January occultation was of great interest to us because of our proximity to the southern path of grazing contact. On account of the apparent diameter of the planet, such a path is not a



In this diagram the ecliptic is horizontal and represents 0° latitude. Conjunctions of Mars with the moon are marked with triangles. The June and July, 1947, occultations were within the dotted region at the right; the September and October, 1948, occurrences will be at the left. Diagrams by Paul W. Stevens.



single line, but is a zone of varying width in accordance with the distances of Mars and the moon from the earth and the altitude of the two at the time of observation. In this case, the belt was about 14.5 miles wide in the vicinity of Rochester. Throughout this narrow region, the fraction of the planet's diameter obscured at the time of maximum occultation varied just as does the maximum magnitude of partial eclipse outside the path of totality of a solar eclipse.

A scale drawing of the Martian disk and the lunar limb indicated the positions of Mars at external contacts and mid-occultation for a maximum occultation of 50 per cent of the planet's disk. The total duration of the phenomenon from first to last contact would be 7¾ minutes, in which time the planet would traverse nearly four minutes of arc of the moon's limb.

A few of our members journeyed out along the shore of Lake Ontario to witness an expected obscuration of approximately 50 per cent, while others observed and photographed the close passage from their homes. Partly clouded skies with snow flurries and high winds hampered observations throughout the region, but intermittently between the clouds the visibility was excellent. Three of us observed at Port Bay, a fourth in Webster, and a fifth in Rochester itself.

With the mid-occultation time scheduled for 12:07 a.m. EST, from Port Bay we last glimpsed Mars at 11:59 and then clouds closed in. At 12:07, fleeting glimpses with 67 power showed detail of the lunar mountains at the dark limb but there was no sign of the planet. At 12:13, half of the Martian disk was visible at the lunar limb through the telescope, and at 12:14 Mars was easily resolved in 6x binoculars. The color contrast was impressive.

At Webster the estimated time of closest approach was 12:10, but lack of continuous observations previously made it difficult to ascertain whether or not there actually had been an occultation from that station. In the city clouds spoiled the show.

PAUL W. STEVENS
Astronomy Section
Rochester Academy of Sciences
Rochester, N. Y.

THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury will be a morning star all month, reaching greatest elongation west, 27° 41′, on the 17th. This will not be a favorable apparition, however, for the planet will rise only about one hour before the sun.

Venus continues as the brilliant object in the west during the evening hours. By the end of March, the planet is −3.8 magnitude and is located 5° southwest of the Pleiades. It sets then four hours after the sun.

Earth reaches heliocentric longitude 180° on March 20th at 16:57 GCT. The sun appears to cross the celestial equator at the vernal equinox. Spring begins in the Northern Hemisphere and autumn in the Southern.

Mars may be viewed the entire night in western Leo. Retrograde motion ceases on March 30th and the planet resumes eastward motion. Its brightness decreases nearly a magnitude during March, from −0.8 to −0.1. Mars will come to within 2½° of Saturn at the end of March.

Jupiter reaches western quadrature on March 18th, rising 4½ hours before the sun.

Saturn is about 12° west of Regulus and continues to retrograde. On March 21-22 the moon will be north of Saturn and Mars.

Uranus can be observed before midnight, 2½° north of Zeta Tauri. Its position and brightness on the 15th are $5^h\ 26^m$, +23° 22′, 6th magnitude.

Neptune will be at opposition on April 1st, hence visible all night, magnitude +7.7. The position on March 15th is $12^h\ 47^m$, −3° 19′.

E. O.

We observed with a 3-inch, 36-power refractor and a pair of 6 x 30 binoculars. The closest approach of the moon to Mars was 13 seconds of arc, from the moon's edge to Mars' edge. The time of closest approach was 10:44 CST. Weather conditions hampered our observing, as the temperature was 16° below zero. The sky was cloudless, but the city haze interfered.

MARTIN KIENITZ
228 Cecil St., S. E.
ARTHUR UPGREN
1625 E. River Rd.
Minneapolis, Minn.

Occultations of the planets have assumed importance in our studies because of a dark band adjacent to the limb of the moon sometimes seen across the face of the planet when it is partly behind the moon. This band has been imputed to the absorbing action of a thin lunar atmosphere and also to a contrast-caused illusion produced by the differing brightnesses of the moon and the planet. Therefore, the Association of Lunar and Planetary Observers wishes to ask well-equipped amateurs who observed the January and February occultations of Mars to report on the appearance or non-visibility of this band. Forms with specific questions have been distributed to our members, and can be sent to any observer who has information to report on the band.

WALTER H. HAAS
University of New Mexico
Albuquerque, N. M.

Mars' occultation was observed here under perfect visibility conditions. With the 32 power of my engineer's transit, I timed first contact at 8:17:28 p.m. PST, with second contact 43 seconds later. Third contact was at 8:40:25, with final emersion of the planet about 30 seconds later. The first contact seemed to be somewhat protracted, that is, the bright edge of the moon approached the planet until it was separated by a thin black line, when it seemed to remain so for several seconds, but moved slightly relative to the planet; then, suddenly, the black line disappeared, and that I regarded as the instant of first contact which I called to my friend who was keeping time.

The second contact was precise and ac-

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SKY PHENOMENA researcher-recorder welcomes observations and clippings of mysterious sky objects. ("Disks," smoke trails, etc.) John P. Bessor, Zelienople, Pa.

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curately timed (8:18:11 p.m. PST), as was the third contact, the ruddy spot of light appearing over the dark lunar limb about a minute or two of arc away from the nearest illuminated surface feature. Fourth contact was also doubtful. I estimate position angle for immersion at 167°, for emersion at 252°.

CARL P. RICHARDS
530 N. 19th St.
Salem, Ore.

Here is a contact print of the Mars conjunction with the moon. The exposure was 1/3 second on Verichrome film through my 3¾-inch refractor with a 1¼-inch Kellner ocular. I had no slow motion nor equatorial mounting and had to risk tripod vibration, and that may explain the slight blurriness of the photograph; also, I used full telescope aperture and no filter.*

HARLAN J. SMITH
Augustana College
Rock Island, Ill.

*Mr. Smith's very presentable photograph reached us too late for an engraving to be made for this issue.—ED.

As the moon approached Mars the planet seemed to become much yellower and the moon whiter in hue. The dark equatorial markings on Mars were very plainly seen. The polar cap pointed right at the moon and was the first place to make contact with the moon. It was one of the best occultations I have seen; the sky was clear, temperature about zero. Mars seemed to head into a valley in the Leibnitz area.

My 5-inch refractor was employed with a power of 250. Immersion occurred at 12:02.5 EST, and the planet took one minute, 20 seconds to disappear completely. My position is at latitude 43° north, longitude 74° 20′ west.

JOHN G. FERRES
600 So. William St.
Johnstown, N. Y.

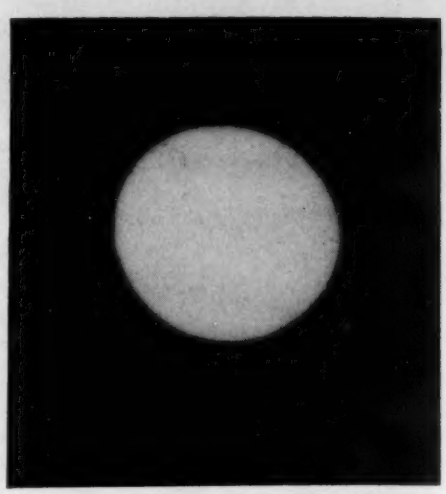
The near occultation of Mars was observed by me from the observatory of the Milwaukee Astronomical Society last night, but at this station Mars was not occulted. I used 432 power, and at closest approach I estimated Mars to be about 10 of its own diameters from the edge of the moon.

ROY R. LEE
3168 S. 97 St.
West Allis 14, Wis.

TWO NEW COMETS

At Lick Observatory, on January 17th, C. A. Wirtanen discovered a 16th-magnitude comet in the constellation of Taurus. It apparently had perihelion passage on November 30th last year, and its magnitude during March was expected to be about 18 or fainter.

At Skalnate Pleso Observatory, Czechoslovakia, on January 18th, Antonin Mrkos found a 10th-magnitude comet in the constellation of Hercules. Parabolic elements set perihelion passage at February 16th, at a distance from the sun of 1.5 astronomical units. Predicted positions for February were: Feb. 3, $17^h\ 40^m.8$, +19° 00′; Feb. 11, $18^h\ 13^m.9$, +24° 01′; Feb. 19, $18^h\ 49^m.0$, +28° 54′.



The moon, with Mars close below it, photographed on January 27th by Gene Waters.

I have taken two pictures of the close passage of the moon to Mars on January 27th, both with Super XX cut film. My camera has a 1⅞-inch lens and 55 inches focal length, and the pictures are enlarged about four times the original size. Mars is on the right just below the moon; they were closest at approximately 10:31 CST, and this picture was taken 10 minutes earlier. My approximate position is 92° 12′ west and 38° 34′ north.

GENE WATERS
108 Fulkerson St.
Jefferson City, Mo.

VARIABLE STAR MAXIMA

March 5, R Geminorum, 7.1, 070122a; 11, T Hydrae, 7.7, 085008; 11, RT Cygni, 7.4, 194048; 18, R Ursae Majoris, 7.6, 103769; 21, S Virginis, 7.1, 132706. April 2, T Aquarii, 7.9, 204405; 5, X Monocerotis, 7.6, 065208.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0 Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

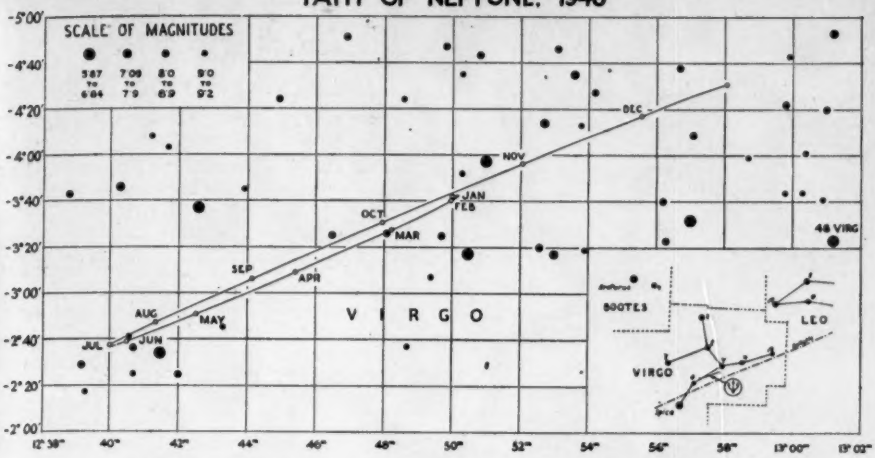
PHASES OF THE MOON

Last quarter	March	2, 16:35
New moon	March	10, 21:15
First quarter	March	18, 12:27
Full moon	March	25, 3:10
Last quarter	April	1, 10:25

MINIMA OF ALGOL

March 1, 21:21; 4, 18:10; 7, 14:59; 10, 11:48; 13, 8:38; 16, 5:27; 19, 2:16; 21, 23:06; 24, 19:55; 27, 16:44; 30, 13:33. April 2, 10:22.

PATH OF NEPTUNE, 1948



The path of the planet Neptune among the stars of Virgo during 1948, from the "Handbook" of the British Astronomical Association. The field is inverted, with south at the top and east at the right, as seen in an astronomical telescope. Neptune is about 8th magnitude.

OCCULTATION PREDICTIONS

February 29-March 1 **172 B Librae** 5.9, 15:35.2 −20-50.8, 20, Em: **A** 11:22.0 −0.6 −3.4 3; **C** 11:27.9 −1.2 −2.4 345; **E** 11:08.6 −1.3 −1.3 328; **F** 11:07.3 −2.1 −0.7 298; **G** 10:38.2 −0.8 +0.1 314; **H** 10:24.5 −1.8 +1.0 270; **I** 10:30.5 −0.8 +0.5 298.

18-19 **BD +27° 1122** 6.5, 6:25.7 +27-0.2, 8, Im: **A** 2:32.9 −1.3 −0.7 77; **B** 2:30.0 −1.4 −0.4 68; **C** 2:29.8 −1.4 −1.1 93; **D** 2:22.2 −1.5 −0.6 80; **E** 2:06.6 −1.8 −1.1 102; **F** 2:17.3 ... ... 150; **H** 1:09.5 −2.3 −0.6 114.

19-20 **c Geminorum** 5.4, 7:40.9 +25-54.6, 9, Im: **F** 7:38.8 −0.8 −0.1 62; **H** 7:13.4 −1.2 −0.9 86; **I** 7:03.8 −1.9 +0.5 48.

20-21 **Upsilon[1] Cancri** 5.7, 8:28.4 +24-15.5, 10, Im: **A** 0:03.6 ... ... 35; **C** 23:41.7 −1.7 +2.5 59; **E** 23:27.4 −0.8 +3.5 47; **F** 23:00.5 −0.8 +1.2 82.

28-29 **Delta Scorpii** 2.5, 15:57.3 −22-28.5, 18, Im: **A** 4:20.3 −0.9 −1.5 86; **C** 4:13.1 −0.5 +0.8 104. Em: **A** 5:17.6 −0.3 −0.4 328; **C** 5:16.4 −0.5 0.0 311.

28-29 **57 B Scorpii** 5.9, 16:03.0 −22-28.0, 18, Em: **A** 9:19.2 −2.3 −0.1 254; **B** 9:16.3 −2.1 −0.2 257; **C** 9:06.6 −3.0 +0.7 242; **D** 9:02.7 −2.5 +0.5 248.

28-29 **27 G Scorpii** 5.8, 16:05.6 −23-32.9, 18, Em: **A** 11:00.0 −1.5 −1.2 280; **C** 10:56.5 −1.8 −1.0 275; **E** 10:27.4 −2.2 −0.4 270; **F** 10:03.9 −4.1 +1.8 238; **G** 9:44.1 −1.8 +1.1 257; **I** 9:24.0 −2.3 +2.5 237.

For selected occultations visible at standard stations in the United States and Canada under fairly favorable conditions, these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, GCT, **a** and **b** quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

A	+72°.5,	+42°.5	**E**	+91°.0,	+40°.0
B	+73°.6,	+45°.6	**F**	+98°.0,	+30°.0
C	+77°.1,	+38°.9	**G**	+114°.0,	+50°.9
D	+79°.4,	+43°.7	**H**	+120°.0,	+36°.0
	I +128°.1,	+49°.5			

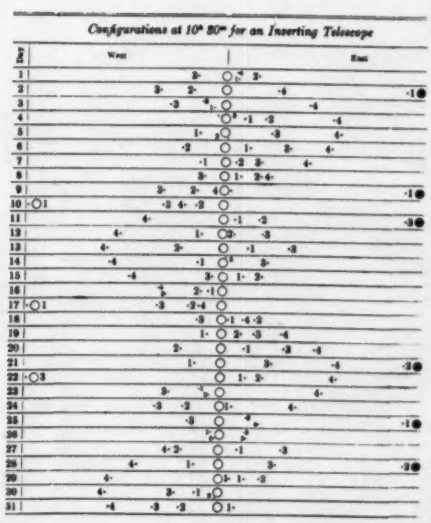
The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the American Ephemeris and Nautical Almanac.



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NEWS NOTES

(Continued from page 120)

they fragments of a disrupted body similar to the earth in composition: metallic core surrounded by increasingly stony layers. The small number of stony meteorites in which there is no free metal represents a thin outer mantle similar to the earth's crust.

Dr. Peter M. Millman, of the Dominion Observatory, discussed 21 spectra of the meteor shower of October 9, 1946. As in other cometary showers, the meteoroids in the wake of Comet Giacobini-Zinner are stony. They show spectral lines of iron, sodium, magnesium, manganese, and calcium, but no lines of ionized atoms. Comparing their spectra with those of the Perseids and the Geminids, Dr. Millman obtained proof for the first time of a relation between the spectra and the velocities of meteors. The slow Giacobinids (23 kilometers per second) show only lines of low excitation; the Geminids (36 kilometers per second) have also lines of the easily ionized element, calcium; while the fast Perseids (61 kilometers per second) show as well the light of ionized magnesium and ionized silicon.

Dr. C. C. Wylie, of the University of Iowa, is dually concerned with the collection of facts about spectacular detonating meteors. First, he wants to get as complete information as possible on such objects in order to determine their orbits and possibly to recover meteorites. Secondly, he feels the urgent necessity to discriminate between meteoric phenomena and the things we may loosely lump under the popular term "flying saucers." Both layman and scientist would benefit by Dr. Wylie's proposed "sky patrol" for looking into such observations immediately after they are reported. The patrolman would be someone trained in meteoritics who would promptly interview people reporting unusual objects. Only by this procedure can conclusive decision be made among observations of fireballs, V-2 rockets, airplanes, balloons, and other unusual phenomena in the sky.

Dr. Wylie has had practical experience in such a patrol covering a few middle western states. Thus he obtained data from which he and his assistants have derived the orbits of three meteoroids for which specimens were recovered. The 1927 fall at Tilden, Ill., yielded four meteorites, the largest of 110 pounds; at Paragould, Ark. (1930), three were recovered, the largest 800 pounds; and the third fall was at Archie, Mo., in 1932. Dr. Wylie believes that three states in his vicinity can be effectively covered by a crew of two full-time men and a secretary, plus volunteer workers in the area. For a nation-wide patrol, several regional directors and considerable numbers of volunteers would be needed. The regional directors should be meteoritical experts; the volunteers would be largely science teachers and Weather Bureau observers.

The Meteoritical Society, where the sky patrol idea has originated, could furnish the regional directors. Its members believe the program would not only obtain better scientific data, but would prevent mass hysteria caused by uncertainties about "flying saucers" being perhaps enemy missiles. The observational training would be an asset to national defense. Anyone interested in this proposed project is encouraged to communicate with members of the Meteoritical Society.

MORE ABOUT THE GREAT COMET

(Continued from page 125)

begin. It is probably true that this may be classed as a great comet, and that we did not see it at its best owing to its great distance from us. It was probably nearest the earth on December 9th, at a distance of 80 million miles, and one observation on that date from Akaroa Lighthouse, whose observers have proven themselves highly efficient in auroral reporting, gives the length of tail as 25 degrees. The nucleus was probably then of 1st magnitude. Taking the report on Halley's comet from the *Memoirs* of the British Astronomical Association, XIX, Part I, 1912, we find that on April 28, 1910, that comet was 84 million miles from the earth and the tail was from 11 to 15 degrees long; the magnitude was about 3rd. Between May 18 and 22, 1910, Halley's comet was 16 million miles from the earth, and the greatest estimate of length of tail was 140 degrees, and the magnitude then could not have been much more than 1st. Generally speaking, therefore, it would seem that this is in fact a greater comet than Halley's. Without exception, however, all people who remember seeing that comet consider that this newcomer bears no comparison in the matter of appearances."

In the remainder of his report, Mr. Thomsen states that observers at the Wanganui City Observatory saw the split nucleus of Comet 1947n, from December 14th to 17th, the nuclear components separated by an amount as great as that of the two components of Alpha Centauri. On December 19th, Mr. Jones also noted the two nuclei, but thought the fainter, following one was a star shining through the tail of the comet.

Mr. Thomsen gives the following as the consensus of the best estimates of the magnitude of the nucleus: Dec. 9, mag. 1; Dec. 11, 2; Dec. 14, 3.5; Dec. 31, 7-8. The length of the tail was about 25° on December 9th; 15°, Dec. 10; 12°, Dec. 11; 20°, Dec. 12; 20°, Dec. 14; 3°, Dec. 16. By December 31st no tail was visible as far as could be learned.

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturers:* Harry S. Everett, Albert B. Shatzel.

March: THE SEASONS. While living through a "year" in the planetarium chamber, the causes of the seasons are shown to be the changes in the sun's daily path resulting from motions of the earth.

April: STARS OF SPRING.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa. Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

March: MARS AND SATURN — MYSTERY WORLDS. What we know, and do not know, about these two planets. THE STORY OF EASTER. Under the Easter stars, the story of the Crucifixion and the Resurrection.

April: BY ROCKET TO THE MOON.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

March: THE EASTER STORY. The story of Easter and the Passover, as matters of the calendar, will be followed by a special program of music and readings in the spirit of the holy day.

April: END OF THE WORLD.

GRIFFITH PLANETARIUM

P. O. Box 9787, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m. Extra show on Sunday at 4:15 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

March: THE STARS OF SPRING. The outlines of the mythological figures are projected in the heavens as an aid in learning the principal stars and constellations of the spring sky.

April: TRAVEL TO THE PLANETS.

HAYDEN PLANETARIUM

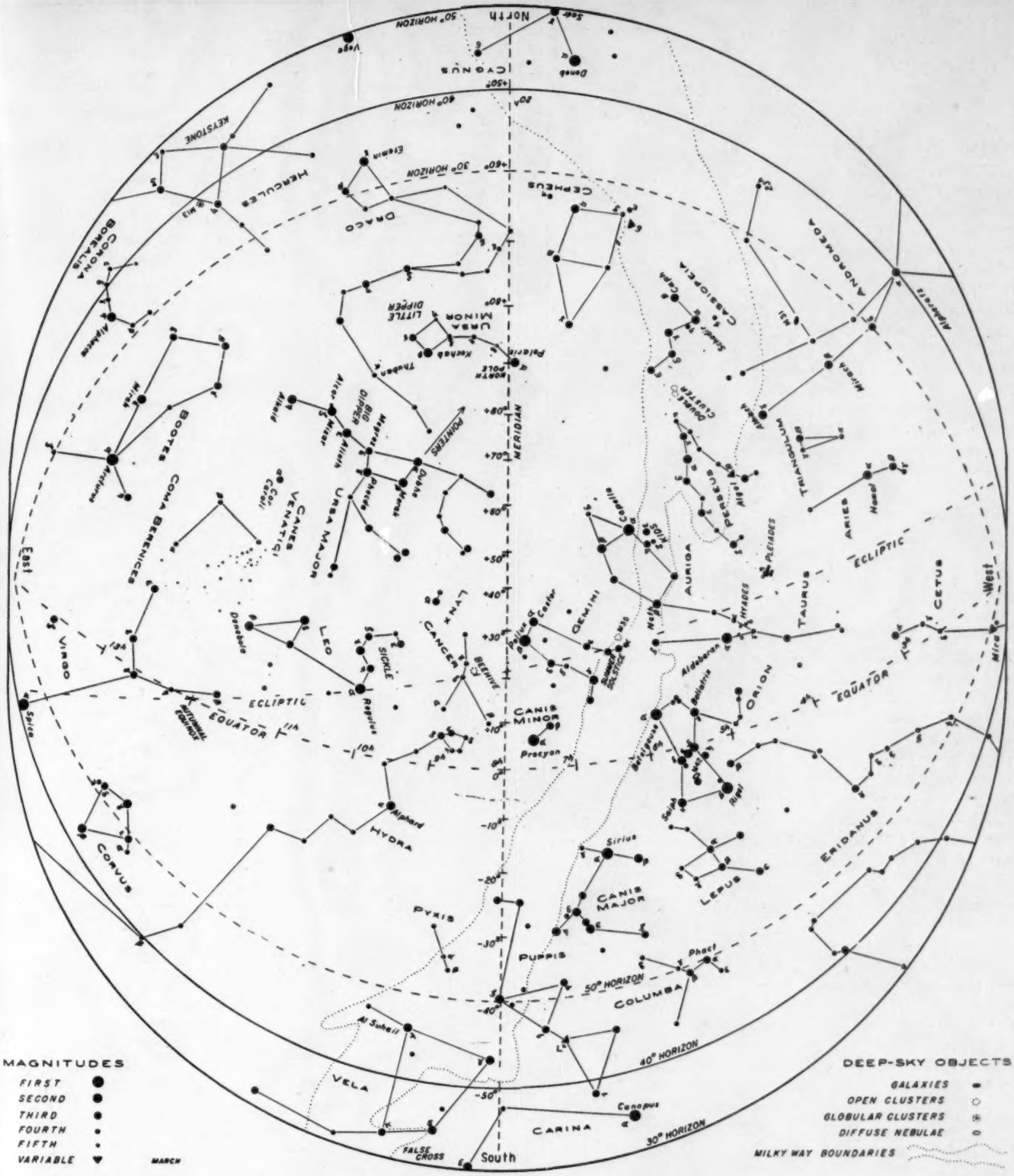
81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

March: RADAR, METEORS AND COMETS. Meteors and comets are different, and yet some meteors are related to comets. Today astronomers are learning much about them, with radar helping in the work.

April: SPRING SKIES.



DEEP-SKY WONDERS

GEMINI has long been a hunting ground for beautiful clusters, most of which are easy to find. Try **NGC 2168,** M35, $6^h\ 06^m$, $+24°\ 21'$, one of the richest clusters available; **NGC 2420,** 1^6, $7^h\ 36^m$, $+21°\ 40'$, a small, diamond-dust cluster on the ecliptic; **NGC 2392,** 45^4, $7^h\ 26^m$, $+21°\ 2'$, a long-known planetary found by Herschel, looking "like a star out of focus," its intricate structure first shown by the Rosse reflector. Amateur telescopes will show the mottled nebulosity.

In the Canis Major-Monoceros region are a number of objects worthy of search. **NGC 2323,** M50, is at $6^h\ 58^m$, $-8°\ 12'$; at $6^h\ 30^m$, $+4°\ 54'$, is **NGC 2244**; these are both open clusters.

Sr. Miguel Cabanach, of Santiago, Cuba, has detected the following errors in the issue of September, 1947, which readers will want to correct: the right ascension of M72 is $20^h\ 49^m$; and the Saturn nebula is NGC 7009. Our respects to the sharp eye of Sr. Cabanach.

WALTER SCOTT HOUSTON

STARS FOR MARCH

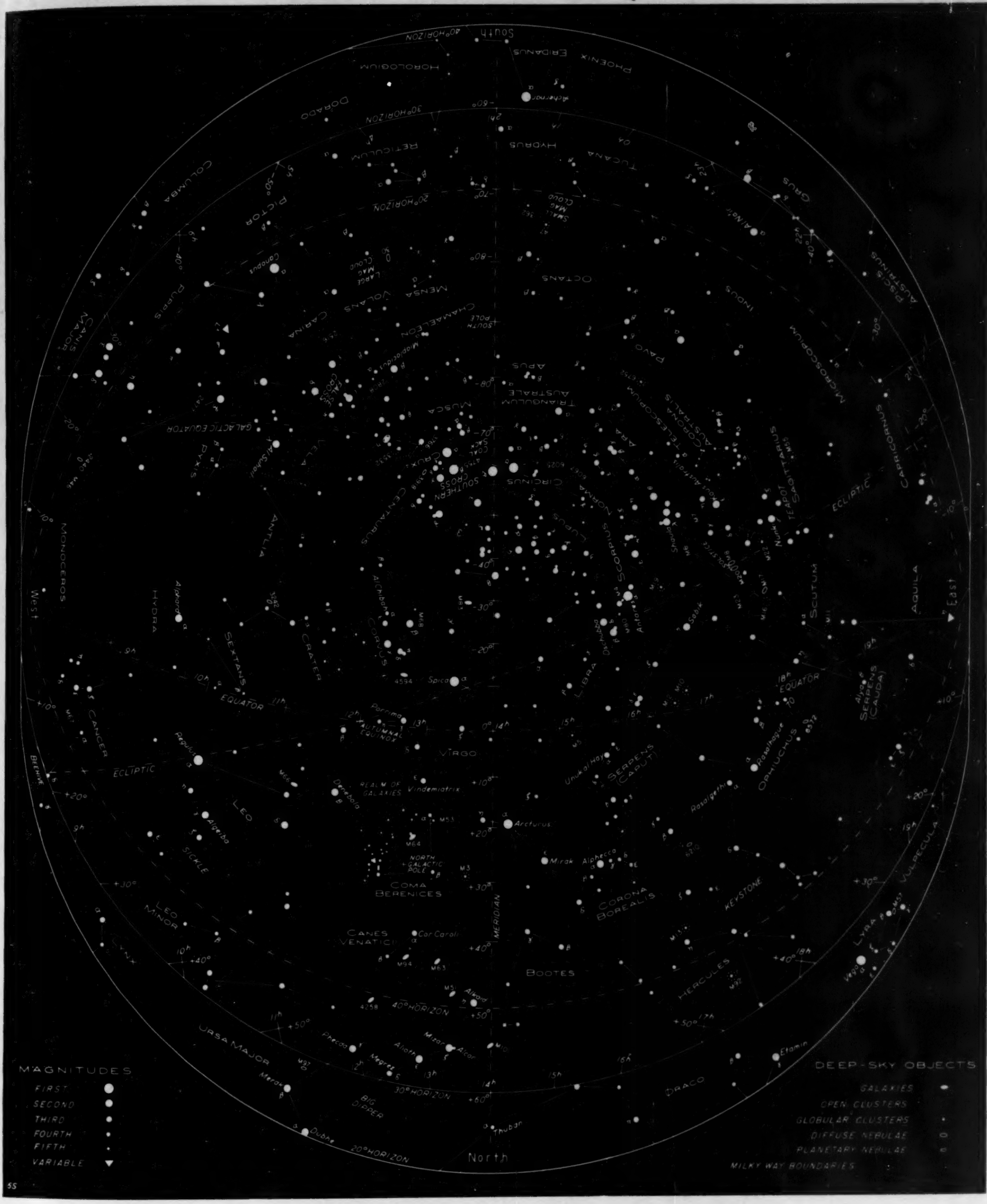
from latitudes 30° to 50° north, at 9 p.m. and 8 p.m. local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. For the year 1948, these simplified charts replace our usual white-on-black maps, which may be consulted in issues of prior years when information on deep-sky wonders and less conspicuous constellations is desired.

HERE AND THERE WITH AMATEURS

The asterisks denote societies whose members receive *Sky and Telescope* as a privilege of membership.
The daggers denote societies which are members of the Astronomical League.

City	*Organization*	*Date*	*P.M.*	*Season*	*Meeting Place*	*Communicate with*
ANN ARBOR	*ANN ARBOR A.A.A.	2nd Mon.	7:30	Oct.-June	U. of Mich. Obs.	Miss E. McLaughlin, 1214 W. Wash., 22885
ATLANTA	ATLANTA AST'MERS	3rd Fri.	7:30	Sept.-June	Agnes Scott College	W. A. Calder, Agnes Scott College
BADEN, PA.	†*BEAVER CO. A.A.A.	2nd Tue.	8:00	Sept.-June	Private homes	Mrs. R. T. LuCaric, Bx. 463, *Baden* 2365
BATTLE CREEK	B. C. A. A. CLUB	2nd Fri.	8:00	Oct.-June	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
BROOKLYN, N. Y.	ASTR. DEPT., B'KLYN INST.	Rd. Table 3rd Thu.	8:15	Oct.-April	Brooklyn Inst.	William Henry, 154 Nassau St., N. Y. C., *BA.* 7-9473
BUFFALO	*A.T.M.s & OBSERVERS	1st, 3rd Wed.	7:30	Oct.-June	Mus. of Science	J. P. Dow, E. Main St., R. D. 3, E. Aurora
CAMBRIDGE	†*BOND AST. CLUB	1st Thu.	8:15	Oct.-June	Harvard Obs.	Miriam Dickey, Harvard Observatory
"	†*A.T.M.s OF BOSTON	2nd Thu.	8:00	Sept.-June	Harvard Obs.	Frank M. Roe, 35 Pemberton St. (40)
CHATTANOOGA	BARNARD A. S.	2nd Fri.	8:00	Oct.-May	Jones Observatory	C. T. Jones, 302 James Bldg., *CHat.* 7-1936
CHICAGO	†*BURNHAM A. S.	2nd Tue.	8:00	Sept.-June	Chi. Acad. of Sciences	J. M. Showalter, 6200 Kenmore Ave.
"	CHICAGO A. S.	Monthly	8:00	.....	Adler Planetarium	Adler Plan., *Wabash* 1428
CINCINNATI	*CIN. A. A.	2nd Fri.	8:00	Sept.-June	Cincinnati Obs.	T. R. Stoner, RR 8, Cin. 30, *BE* 7937-R
"	*CIN. A. S.	3rd Wed.	8:00	Sept.-June	5556 Raceview Ave.	A. C. Moore, 5548 Raceview Ave. (11)
CLEVELAND	CLEVELAND A. S.	Fri.	8:00	Sept.-June	Warner & Swasey Obs.	Virginia Burger, Warner & Swasey Obs.
COLUMBIA, S. C.	NORTH'N CROSS A.S.	Every Mon.	8:15	All year	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
COLUMBUS, OHIO	*COLUMBUS A. S.	Last Tue.	8:00	All year	McMillin Obs.	J. A. Hynek, Ohio State Univ.
DAYTON	A.T.M.s OF DAYTON	3rd Sat.	Eve.	.....	Private homes	W. C. Braun, New Lebanon
DAYTONA BEACH	D. B. STARGAZERS	Alt. Mon.	8:00	Nov.-June	500 S. Ridgewood Ave.	Rolland E. Stevens, 500 S. Ridgewood
DETROIT	†*DETROIT A. S.	2nd Sun.	3:00	Sept.-June	Wayne U., Rm. 187	E. R. Phelps, Wayne University
"	†*N. W. DETROIT A.S.	1st Tue.	8:00	Sept.-June	Redford High Sch.	John W. Broxholm, 21412 Pickford
DULUTH, MINN.	†*DARLING AST. CLUB	1st, 3rd Fri.	8:00	All year	Darling Observatory	Mrs. Rachel Bulkley, 1317 N. 5 St., Superior, Wis., 4507
FT. WORTH	TEX. OBSERVERS	No regular meetings				Oscar E. Monnig, 1010 Morningside Dr.
GADSDEN, ALA.	ALA. A. A.	1st Thu.	7:30	All year	Ala. Power Audit.	Brent L. Harrell, 1176 *W* or 55
GENEVA, ILL.	*FOX VALLEY A. S.	3rd Tue.	8:00	.....	Geneva City Hall	Joseph Zoda, 501 S. 6th, St. Charles
HOUSTON	*HOUSTON A. S.	Last Fri.	7:30	All year	Mus. Nat. Hist. Annex	W. D. Martin, 1810 Sunnyland St.
INDIANAPOLIS	†INDIANA A. S.	1st Sun.	2:15	All year	Riley Library	E. W. Johnson, 808 Peoples Bank Bldg.
JACKSONVILLE	*J. A. A. C.	1st, 3rd. Mon.	8:00	All year	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
JERSEY CITY, N. J.	†REVERE BOYS CLUB	Mon., Tue.	7:15	All year	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
JOLIET, ILL.	†JOLIET A. S.	3rd Mon.	8:00	Oct.-May	Jol. Township H. S.	Mrs. Robert L. Price, 403 Second Ave.
KALAMAZOO	†KALAMAZOO A.A.A.	Sat.	8:00	Mar.-Dec.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
KEY WEST, FLA.	†KEY WEST AST. CLUB	1st Wed.	8:00	All year	Private homes	W. M. Whitley, 1307 Div. St., 724-R
LOS ANGELES	L.A.A.S.	2nd Tue.	7:45	.....	Griffith Obs.	H. L. Freeman, Griffith Obs.
LOUISVILLE, KY.	†L'VILLE A. S.	1st Tue.	8:00	Sept.-May[1]	Univ. of Louisville	B. F. Kubaugh, 621 34th St.
MADISON, WIS.	†MADISON A. S.	2nd Wed.	8:00	All year	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
MEMPHIS	A.T.M.s OF MEM.	Meetings suspended				R. E. Wendt, Jr., 2084 Linden Ave.
MIAMI, FLA.	SOUTH'N CROSS A.S.	Every Fri.	7:30	All year	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26th Road
MILWAUKEE	†*MILW. A. S.	1st Thu.	6:15	Oct.-May[2]	City Club	E. A. Halbach, 2971 S. 52 St., W. Allis
MINNEAPOLIS	M'POLIS A. C.	1st, 3rd Wed.	.....	.....	Public Library	Mrs. A. Ljungren, 4054 Russell Ave. N. (12)
MOLINE, ILL.	†*POP. AST. CLUB	Wed.[3]	7:30	Feb.-Nov.	Sky Ridge Obs.	Carl H. Gamble, Route 1
NASHVILLE	*BARNARD A. S.	2nd Thu.	7:30	All year	Vanderbilt Univ.	E. Keller, 2716 Hartford Dr. (11), 5-0766
NEW HAVEN	†NEW HAVEN A.A.S.	Last Sat.	8:00	Sept.-June	Yale Obs.	J. J. Neale, 29 Fairmont Ave.
NEW ORLEANS	A.S. OF N. ORLEANS	Last Wed.	8:00	Sept.-May	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
NEW YORK	*A.A.A.	1st Wed.	8:15	Oct.-May	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., *EN.* 2-8500
"	†JUNIOR AST. CLUB	3rd Sat.	Aft.	Oct.-May	Amer. Mus. Nat. Hist.	J. B. Rothschild, Hayden Plan., *EN.* 2-8500
NORFOLK, VA.	†*A.A.S. OF NORFOLK	2nd, 4th Thu.	8:00	All year	635 W. 29th St.	P. N. Anderson, 635 W. 29th St.
NORWALK, CAL.	EXCELSIOR TEL. CLUB	Thu.	7:00	All year	Excelsior Union H. S.	Geo. F. Joyner, 410 Sproul St.
NORWALK, CONN.	NORWALK AST. SOC.	Last Fri.	8:00	Sept.-June	Private houses	Mrs. A. Hamilton, 4 Union Pk., 6-5947
OAKLAND, CAL.	†*EASTBAY A. A.	1st Sat.	8:00	Sept.-June	Chabot Obs.	Miss H. E. Neall, 1626 Chestnut, B'keley
OWENSBORO, KY.	†*OWENSBORO A. C.	3rd Sat.	8:00	All year	Public Library	Herman Batt, 1507 Hathaway St.
PALO ALTO, CAL.	*AST. & TEL. CLUB	1st, 3rd. Fri.	7:30	All year	Community Center	Marvin J. Vann, 301 Oxford Ave.
PHILADELPHIA	A. A. OF F. I.	3rd Fri.	8:00	All year	The Franklin Inst.	Edwin F. Bailey, *Rit.* 3050
"	*RITTENHOUSE A. S.	2nd Fri.	8:00	Oct.-May	Morgan Physics, U. Pa.	Sarah Lippincott, Sproul Obs., Swarthmore
PITTSBURGH	†*A.A.A. OF P'BURGH	2nd Fri.	8:00	Sept.-June	Buhl Planetarium	Louis E. Bier, 837 Estella St.
PONTIAC, MICH.	*PONTIAC A.A.A.	2nd Thu.	8:00	All year	Private homes	Mrs. M. Chircop, 147 Prospect St., 21455
PORTLAND, ME.	†A. S. OF MAINE	2nd Fri.	8:00	All year	Private homes	H. M. Harris, 27 Victory Ave., S. Portland
PORTLAND, ORE.	†*PORTLAND A. S.	1st Wed.	7:00	All year	Central Pub. Lib.	H. J. Carruthers, 427 S. E. 61 Ave.
"	†A. T. M. & O.'s	2nd Tue.	8:00	All year	Private homes	N. C. Smale, 831 N. Watts St.
PROVIDENCE, R. I.	SKYSCRAPERS, INC.	Mon. or Wed.	8:00	All year	Ladd Observatory	Ladd Obs., Brown U., *GA.* 1633
RENO, NEV.	A. S. OF NEV.	4th Wed.	8:00	All year	Univ. of Nevada	G. B. Blair, University of Nevada
ROCHESTER, N. Y.	ROCH. AST. CLUB	Alt. Fri.	8:00	Oct.-May	Univ. of Rochester	Edwin M. Root, 110 Hamilton St.
ROCKY MOUNT, N.C.	HI-Y A. C.	Tue.	8:00	.....	YMCA	J. A. Harper, YMCA
RUTHERFORD, N. J.	RUTHERFORD A. S.	1st Thu.	.....	.....	Private homes	W. C. Fillebrown, 273 Lawton Ave.
SACRAMENTO	SAC. VAL. A. S.	.....	8:00	All year	Sacramento College	Miss E. Champ, 3816 Sac'to Blvd., 5-9116
SAN DIEGO, CAL.	AST. SOC. OF S. D.	1st Fri.	7:30	Oct.-June	504 Elec. Bldg.	W. T. Skilling, 3140 Sixth Ave.
"	†A.T.M. AST. CLUB	2nd, 4th Mon.	7:30	All year	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, *Bayview* 3757
SCHENECTADY	S'TADY AST. CLUB	3rd Mon.	8:00	All year	Schenectady Museum	G. Staffa, 32 Front St.
SOUTH BEND, IND.	ST. JOS'PH VAL. AST.	Last Tue.	8:00	All year	928 Oak Street	F. K. Czyzewski, South Bend Tribune
SPRINGFIELD, VT.	†SPRINGFIELD T. M.'s	1st Sat.	6:00	All year	Stellafane	John W. Lovely, 27 Pearl St., 535-W
ST. LOUIS	ST. LOUIS A. A. S.	1st Sat.	.....	All year	Private homes	A. M. Obrecht, 2913 Park Ave.
STAMFORD, CONN.	STAMFORD A. A.	3rd Fri.	8:00	All year	Stamford Museum	Wm. L. Dutton, Box 331, Noroton
TACOMA, WASH.	TACOMA A. A.	1st Mon.	8:00	All year	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 No. Union Ave.
TEANECK, N. J.	†BERGEN CO. A. S.	2nd Wed.	8:30	All year	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
TULSA, OKLA.	†TULSA A. S.	Occasional meetings				V. L. Jones, 4-8462
WANTAGH, N. Y.	LONG ISLAND A. S.	Sat.	8:00	All year	Private homes	A. R. Luechinger, Seaford Ave., 1571
WARREN, OHIO	†MAHONING VAL. A.S.	Thu.[4]	8:00	All year	Private homes	S. A. Hoynos, 1574 Sheridan, N.E., 25034
WASHINGTON, D.C.	†NAT'L CAP. AST'MERS	1st Sat.	8:00	Sept.-June	U.S. Nat'l. Museum	Jewell Boling, 1717 P St. N.W., *Du.* 2969
WICHITA, KANS.	†*WICHITA A. S.	1st Wed.	8:00	All year	To be announced	Dollie Ratcliff, 801 Maple, 2-1822
WINSTON-SALEM	†*FORSYTH A. S.	Last Fri.	7:30	All year	Private homes	Kenneth Shepherd, 703 W. E. Blvd.
WORCESTER, MASS.	†*ALDRICH AST. CLUB	1st, 3rd Tue.	7:30	All year	Mus. Natural History	Ralph A. Wright, 4 Mason St.
YAKIMA, WASH.	†YAK. AM. AST'MERS	1st Tue.	8:00	All year	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.

[1]June, **Jul.**, Aug., informal meetings. [2]Dinner meeting. [3]Nearest 1st-quarter moon. [4]1st or 2nd Sun., June-Sept.



EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on May 7th at 11 p.m., May 23rd at 10 p.m., June 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of May and July, 1946; alternate issues, October, 1946, to August, 1947, and September, 1947, to January, 1948.

THE 200 INCH TELESCOPE
LOOKING
EAST